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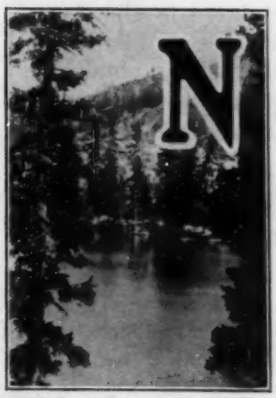
The Spillway at the Intake of the Las Plumas Power Plant.

RECENT ELECTROCHEMICAL DEVELOPMENTS

BY J. W. BECKMAN.

(Electro-chemical utilization of water power in the West has long been heralded as of immense importance to economic use of her gigantic water powers. Herein is an article describing the first successful Western electro-chemical plant, written by the electrical engineer employed in its design.—The Editor.)



Lake Storage in High Sierras.

NOT much more than a generation ago the Pacific Coast was primarily interested in gold mines and the necessities of life, such as flour and meat, as well as clothing.

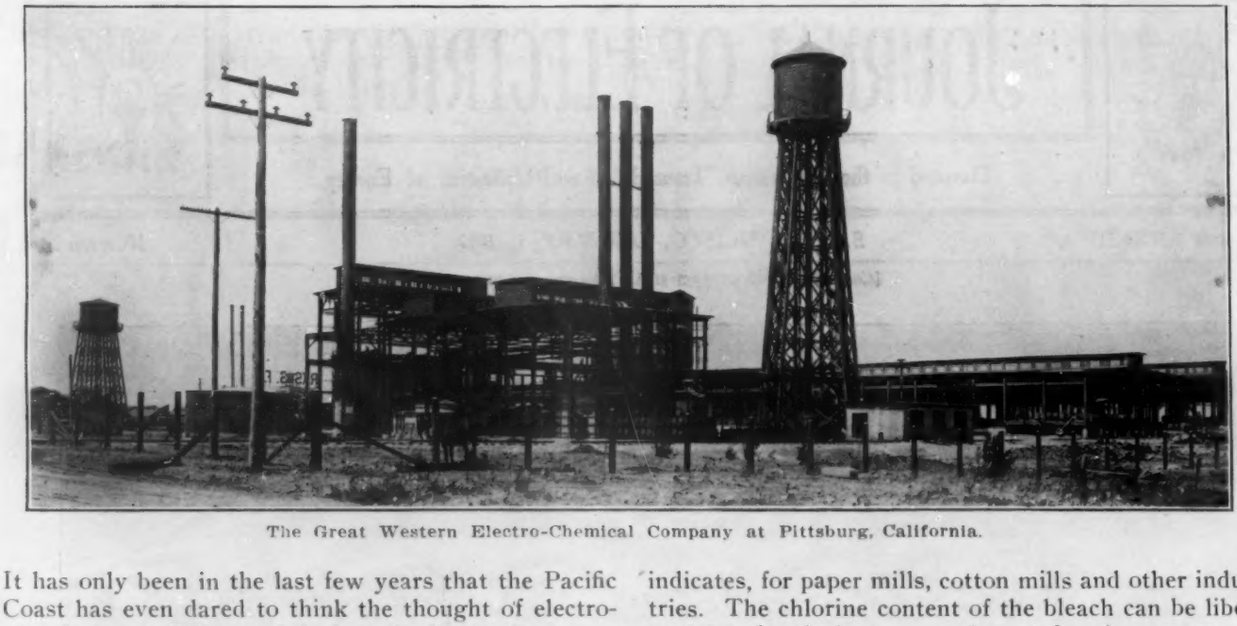
As the population has grown the interests on the Pacific Coast have never been completely diverted from gold mining, but new interests have been developed, more or less dependent on the stimulus due to the gold mines. It is only within a comparatively short space of time that industries completely independent of the gold mining industries have begun to spring forth.

Such are the chemical industries and other activities which derive their raw materials either from the baser minerals prevalent in the ground, or the timbers covering the slopes of the Sierras.

The abundant snow fall, on the high levels in the Sierra mountains, has always been a producer of great quantities of water, which the early miners used in their hydraulicking the gold out of the old river channels. They little dreamt in those days that this water, seeking a lower level, could be harnessed and its forces transmitted through slender wires to different parts of the state, and there let loose again for the purpose of producing happiness and wealth to the dwellers of the country.

One of the most recent types of new commercial activities that has been developed in the United States, and developed at a stupendous rate, is the electrochemical industry. The electrochemical industry is dependent upon various raw materials in addition to an abundant permanent cheap supply of electric power.

Niagara Falls, New York, has long been considered a Mecca for the electrochemical industries of the world, due to the enormous power developments there.



The Great Western Electro-Chemical Company at Pittsburg, California.

It has only been in the last few years that the Pacific Coast has even dared to think the thought of electrochemical possibility and it is only in the last year that electrochemical industries have actually been operating on the Pacific Coast.

Progressive financiers, together with the Great Western Power Company saw the possibility of establishing electrochemical industries on the Pacific Coast and organized a company known as the Great Western Electrochemical Company, for the purpose of operating electrochemical plants and manufacturing electrochemical products.

The first installation made by this company was for the purpose of manufacturing caustic soda and bleaching powder, also known as chloride of lime. Caustic soda is one of the staple products in the world's market. It is used in the households, as well as in nearly every industry imaginable. The soap industry, which by its development acts as an indication as to a people's degree of civilization, needs caustic soda as one of its primary raw materials. Refining oil, the manufacture of rubber, the cotton mills—all of them need caustic soda for one purpose or the other.

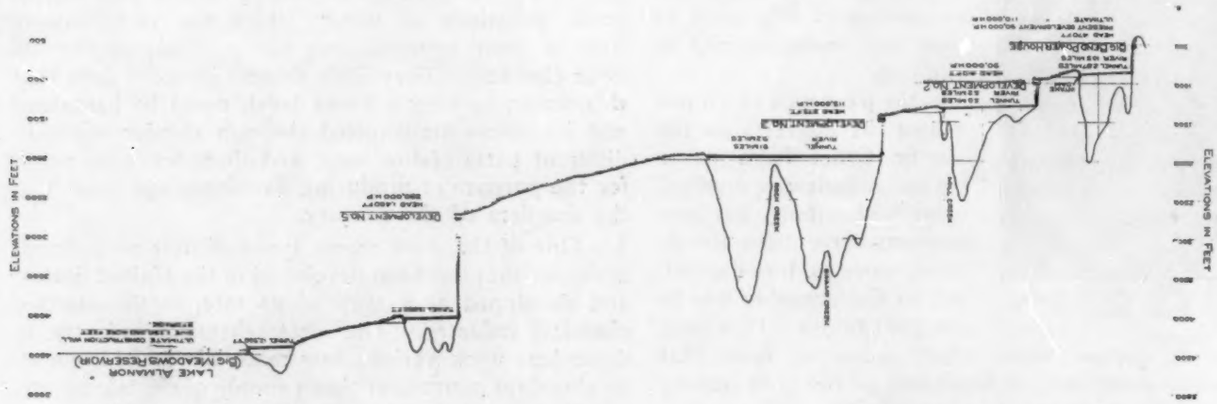
Bleaching powder on the other hand is used as a disinfectant in households for purifying drinking water supplies and also as a bleaching agent, as its name indicates, for paper mills, cotton mills and other industries. The chlorine content of the bleach can be liberated by chemical means and used for the purpose of chlorinating various materials, such as ores and chemicals, the bleach being a very convenient chlorine carrier.

The Pacific Coast with its growing industries furnishes the natural outlet for this first caustic soda and bleach plant in this locality, consuming in its various oil refineries, soap factories, etc., all the caustic soda produced and the growing paper pulp industry on the Pacific Coast takes care of the bleach output.

The total tonnage of finished products shipped out at present from the Great Western Electrochemical plant is 15,000 tons in a year.

The Great Western Electrochemical Company's plant is located at Pittsburg, California, and is the first plant in the United States of this type located on tide water, and the only one of any nature west of Detroit.

The raw materials which go into the manufacture of the caustic soda and bleach are common salt and burnt lime. The salt is produced in abundance at various points along the Pacific Coast and limestone from which the burnt lime is derived is obtainable



Profile of Present and Proposed Developments on the North Fork of the Feather River.

from a number of deposits in the Santa Cruz mountains, as well as in the Sierra Nevada Mountains.

The primary chemical reactions underlying the manufacture of caustic soda and bleaching powder, are extremely simple. The salt is submitted to the action of the direct current in suitable cells, by which sodium and chlorine are liberated. The sodium forming with the water present, caustic soda, and the chlorine, being a gas is carried off and is absorbed in suitable chambers by lime, forming the bleaching powder.

The following chemical formula indicates what takes place with the salt under the influence of the electric current:

$$Na\,Cl + H_2O = Na\,OH + Cl + H.$$

The chlorine is absorbed in slacked lime as follows:

$$Ca\,(OH)_2 + 2\,Cl = CaOCl_2 + H_2O.$$

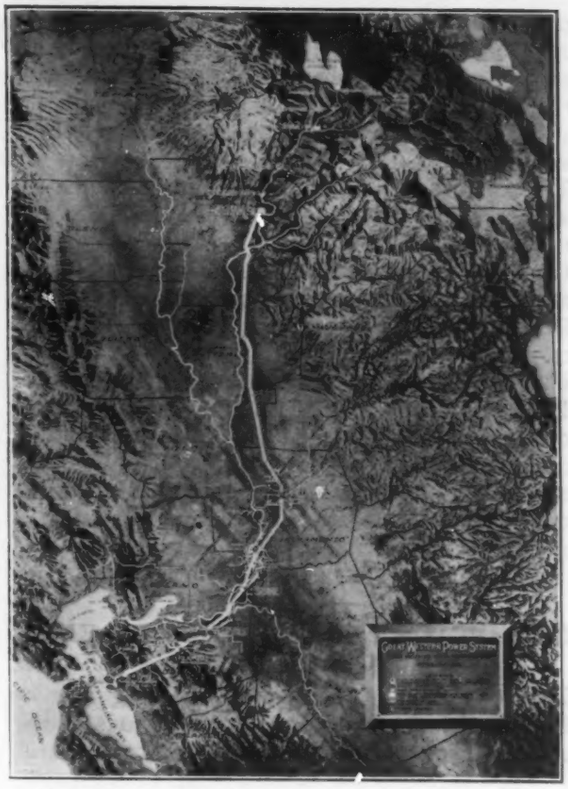
From this it is apparent that the electrcal energy which is used for the electrolytic production of these materials is in the nature of direct current. The Great Western Power Company furnishes alternating current to the chemical company. This energy is passed through five rotary converters, whose output is the direct current used in the electrolysis of the salt solution.

Each converter supplies current to a battery of cells. The cells are narrow chambers which are practically divided into two compartments separated from each other by a porous diaphragm. In one compartment an electrode of graphite dips down, which is the positive pole, and there the chlorine is liberated, while in the other compartment an iron electrode is placed which acts as negative pole where the caustic soda is obtained. There is a continuous flow of salt brine into the cells and an equally continuous flow of caustic soda admixed with some salt from the cells. The cells operate at a voltage of less than 5 volts and a number of cells are placed in series to take care of the voltage which the rotary converter delivers. The Allen-Moore cell is used exclusively and with success in this plant, as is the case in many installations in the east.

The salt brine which is admitted to the cells has to be practically chemically pure. This is accomplished by treating the salt solution with various chemicals and in such manner eliminate various impurities.

The caustic soda which is collected in troughs from the different cells is conveyed by pipes to a large storage tank, from which it is drawn off from time to tine into large vacuum concentrating pans. In these pans the salt is separated out from the caustic soda and finally a pure caustic soda liquor is obtained which in some cases is shipped out in tank cars, while in other cases it is permitted to flow into enormous big iron pots which are externally heated and where the caustic is finally liberated from all water and is obtained in a molten condition. In this shape the caustic is poured into the commercial steel drum in which it is shipped to all parts of the world.

The chlorine is conveyed by means of pipes to a series of chambers whose floors are covered by a layer of hydrated lime. After a specific number of hours of exposure the lime has absorbed chlorine to complete saturation and the product which is bleaching powder,



Storage Reservoir, Power House and Transmission System of the Great Western Power Company.

is shoveled out and placed in large steel drum containers, in which it is shipped to the consumers.

The hydrogen which is liberated as shown in the chemical formula, can be collected and used, but is as a rule permitted to escape into the air.

The Great Western Electrochemical Company's plant covers a considerable part of nine acres of ground, at Pittsburg, California. The buildings are of the very best construction. In the case of the cell and generator rooms, they are built of brick, while the building housing the bleach chambers is an open wooden structure and the evaporator house containing boilers, pots and the vacuum pans, is a steel structure. The necessary storehouse and machine shop are structures covered by asbestos corrugated steel.

In connection with operating a plant of this type, there is needed considerable amount of chemical skill.

Interior View of Las Plumas Power Plant.

To take care of the chemical end there is erected a laboratory divided into two parts. One is the so-called routine laboratory where the operating analyses are carried out, while the other part is the research laboratory in which any problems in connection with the operation, or future developments, are carefully studied.

The suitable administration building near the entrance gate, furnishes headquarters for the office and engineering force.

The Great Western Electrochemical Company is capitalized at two and one-half millions and its first installation has cost about six hundred thousand dollars.

The plant has been in operation for the last five months and has turned out goods of the same standard as those that are made by the eastern manufacturers. The company is in active charge of Mr. John F. Bush, formerly closely associated with some of the industries of similar type in the east. The firm of Bush, Beach & Gent, chemical brokers of New York and San Francisco, market the complete output from this plant.

RECLAIMING OF ALKALI LANDS BY ELECTRICAL PUMPS.

Electricity is playing an ever widening role of activity in reclaiming apparently useless lands in the West. First came the electric pump to irrigate arid lands. Then followed the electric pump to drain submerged lands and later irrigate them at proper intervals. Now comes the successful reclamation of alkali lands by electrical means.

Evidence that worthless alkali land can be restored to fertility by washing down the alkali through flooding, and preventing recurrence of alkali trouble by drainage and electric pumping, is given by the University of California in a "Preliminary Report on Kearney Vineyard Experimental Drain," just published by the University of California and obtainable free by writing to the College of Agriculture at Berkeley.

To remove the alkali, all of the land was flooded for a week to a depth of six to twelve inches. The water was then removed, through the drainage system and by working an electric pump. As much as forty acres were under water at one time, so that the alkali should be carried downward rather than washed out laterally. The land was flooded in a similar way the following year. The water table has been kept low by pumping. The result is that flooding in two successive years and drainage has reduced the alkali to an amount considered safe for crops. After three years, the tract, previously worthless, this year produced a crop of 180 tons of grain hay, and the land is believed to be in such a condition that alfalfa can be successfully grown in 1917.

The work was, however, expensive. The cost was approximately $100 an acre. This cost was largely due, however, to the fact that the work was experimental in character. It is believed by the College of Agriculture that with the next piece of alkali land on which similar reclamation work is undertaken by the University that it will be possible to bring the cost within sixty dollars an acre.

THE USE OF NATIONAL FORESTS FOR WATERPOWER DEVELOPMENT.

In the fiscal year 1916, says Henry S. Graves, Chief of the Forest Service, in his annual report, 20 new waterpower projects which utilize National Forest land began operation. This was an increase of 18½ per cent in the total number. In the fiscal year 1915 the number of new projects which began operation was 12. Forty-two per cent of the total developed waterpower of the United States utilize National Forest land, the Forest Service figures show.

Development of relatively small projects is particularly in evidence, according to Mr. Graves, in the Rocky Mountain states. California leads in the amount of power under permit and in operation. The number of transmission line permits in effect was increased by 13 during the year. The 40 applications for power-project permits received in 1916 included 8 from Alaska—a notable evidence, according to the report, of increased local interest in power development on National Forest lands there.

Concerning the report prepared by the Forest Service in response to a resolution of the Senate calling upon the Secretary of Agriculture for information regarding the ownership and control of waterpower sites and any facts bearing on the question as to the existence of a monopoly in the ownership and control of hydroelectric power in the United States, Mr. Graves says: "This report presented in far greater detail than has ever been attempted before an exhaustive analysis of the general power situation. It showed a marked concentration of definite and complete control of a large percentage of developed waterpower by a very few companies. Data presented regarding interrelationships through common directors and principal officers indicated a marked tendency toward association or community of interests, particularly between the principal holding companies. The movement toward concentration in commercial central stations of all the primary power employed in the electrical industries and in manufactures was found in all sections of the United States, the rate of concentration during the period 1902-1912 being highest in the South Atlantic States and the extent of concentration greatest in the Western States.

The rate of increase in waterpower development for public service use from 1902-1912 was approximately three times as great as in steam power. Primary power installation from all sources and for all uses increased from 1902 to 1912 more than 2½ times as rapidly in the eleven Western States as in the remainder of the United States, while the increase for primary electric power for the same period was 440 per cent for the Western States, as against 226 per cent in the other states. The development per capita of the Western States in 1912 and 2½ times as great as in other parts of the country.

The report showed a considerable over-development in nearly all the power centers of the Western States—California, Oregon and Washington in particular showing installations far in excess of maximum demands.

A BUREAU OF GOVERNMENTAL RESEARCH

BY BRUCE CORNWALL

(Here is an account of an incorporated non-partisan citizens' agency formed for the purpose of studying public business, for co-operating with officials and especially for promoting economy and efficiency in municipal affairs. In view of the millions of dollars being invested in public engineering enterprises of the West, this article, by the chairman of the Board of Trustees of the San Francisco Bureau of Governmental Research, should prove exceptionally timely.—The Editor.)

San Francisco men and women after the fire of 1906 rebuilt their city principally in steel, reinforced concrete and brick, spending thereon more than $325,000,000, and yet, after it was done, of the eleven principal cities of the United States, San Francisco had the lowest percentage of mortgage debt on real estate—only 18 per cent of the value of real estate and improvements. In every line of activity there has been a remarkable growth, notably in savings bank deposits, commercial and national bank deposits and resources, bank clearings, postal receipts, import and export shipping tonnage movement arrivals almost beyond belief. But—

One significant fact which stands against this proud record is this: In the past fifteen years San Francisco's population has increased about 46 per cent, while her municipal expenditures have increased 165 per cent.

Realization of this fact led to the appointment of the San Francisco Tax Committee and the employment of the Bureau of Municipal Research of New York to make a survey of the city governmet. The survey has been made.

On the 19th day of October, 1916, there was incorporated the San Francisco Bureau of Governmental Research, to follow up the recommendations of the survey. The taxpayers of San Francisco, interested in accomplishing the work thus undertaken, have guaranteed the bureau $100,000 to follow up the survey report. The Bureau of Research will begin its active work on January 1st.

The people want San Francisco to begin now to operate its business economically and efficiently, and not to wait, as did New York City, until forced to act by threatened bankruptcy. The San Francisco municipal bonded debt has increased year by year from a debt of $4,296,600 in 1907, to a debt of $44,720,700 in 1916. The annual interest paid on this bonded debt has increased from $152,524 in 1907, to $2,101,317 in 1916.

Under similar but more aggravated circumstances in New York a few years ago, recourse was had to a similar remedy, and this year in his speech to a committee at the Hotel Astor, Mayor Mitchell was enabled to say:

"By most careful budget making and use of appropriations, the administrative cost of the government has been cut $3,125,000. . . Notwithstanding this reduction, great extensions in service have been made. The record is clear on this point for any one to read."

We are going to try to make it possible for a mayor of San Francisco to truthfully make a similar statement in San Francisco some time within the next few years.

A great majority of citizens and officials actually want efficiency, economy and honesty in public affairs, and actually resent waste, incompetency and dishonesty. However, many citizens, after long years of suffering, have come to have a firm, fatalistic belief that municipal government must be less competent and less honest than private business.

It is the purpose of the San Francisco Bureau of Governmental Research to largely disprove this fatalistic belief and to offer a way to improve, if not perfect, local government.

It is naturally asked, "How are you going to do this? What authority have you, a private organization, to make you think you can accomplish anything with public officials?" A private bureau of research has no authority behind it to enforce its principals, save and except the authority of public opinion. But what better authority is there anywhere than determined public opinion? And in what work has the public a more general or deeper interest than in this?

First, consider the effect taxation has upon the general business of a community, not only as a burden imposed upon citizens which prevents the use of income for other purposes, but also the effect it has as an anticipated burden upon individuals and associations of individuals considering the adoption of the city as a home.

In the neighborhood of San Francisco and tributary to the bay, there are many cities and towns within which a new industry or enterprise may contemplate making its home. In deciding which of these cities to locate in, the subject of the rate of taxation is a prime consideration. It is to the interest of every one in San Francisco, therefore, to keep the rate of taxation down as low as possible consistent with good service, in order to attract to San Francisco new people and new enterprises.

Second, we live in a time when government is extending. The principle that was taught a few years ago as the fundamental principle of government—that the least governed people is the best governed people—is no longer generally accepted as true. Society today demands more from government and every year additional functions of government are adopted. The cost of government is increased necessarily with the adoption of each new function. While formerly we could worry along well enough with a simple system subject to political abuse, it has, under the new order, become necessary that government be efficient and that the old haphazard and extravagant customs be set aside. It is of material and considerable interest to every citizen, therefore, that the machinery of government be made as perfect as possible in order that the expense of all of the activities of government may be borne without individual suffering or community disaster.

Now the present situation in the first eleven cities by population of the United States is this:

The cost for government to each individual city in the year 1915 was as follows:

New York	$45.85
Chicago	33.97
Philadelphia	28.67
St. Louis	31.32
Boston	49.29
Cleveland	41.20
Baltimore	39.83
Pittsburgh	39.89
Detroit	38.44
Buffalo	38.61
San Francisco	53.88

and the average cost throughout the United States was **$30.17.**

These figures, given by the United States Census Bureau, are authentic, and it does not seem necessary to go further to find the reason why we in San Francisco should become busy in putting our house in order.

How Are We Going to Go About This Task?

Briefly, we are first going to maintain a careful, daily watch for ourselves throughout the city government. In this, of course, we are greatly assisted by the very excellent survey already made by the New York Bureau of Municipal Research. No official will suffer from any publicity from the Bureau of Research unless he denies provable facts, exhibits deplorable incompetence, or tries to confuse the public mind with respect to the significance of defects noted.

We hope and we aim to keep the public activities of the bureau impersonal; to keep out of politics, and to work with the elected officials, whoever they may be, looking out as the citizens' agent for the citizens' interests each day in the year.

We expect to accomplish this: Increased and better service at less cost; one dollar's worth of service for $1.00 of taxes paid. We expect to improve the efficiency in the handling of public business so that the cost of operation will be cut sufficiently to save funds for additional requirements.

We intend to study the city's debt and to make it a matter of plain understanding to all voting citizens. We will inquire into the waste of bonded debt and consider the proposition of the pay-as-you-go policy. As an instance of what is meant, let us consider our present school bonds.

Of these there have been issued since 1904, $7,216,400. When these bonds are retired, in addition to the payment of more than seven millions of dollars, the taxpayers of the city will have paid $4,255,592.79 for the use of the money. It is now generally believed that this is bad municipal business. It is urged that non-income-producing, permanent improvements should be paid for in the actual tax budgets. While it may temporarily mean a somewhat heavier burden, it will ultimately result in a reduction in the budget and be an economic saving, and in dollars and cents it will cost the taxpayers 50 per cent less than the old, long-term bond policy.

We are going to try to improve the city's budget making; try to standardize supplies and salaries; try to do away with useless and superfluous positions. In other words, we are going to try to get an intelligent consideration of the 703 specific recommendations for improved, efficient government contained in the survey report, and also of such other recommendations as our local bureau may make after careful investigation and study. We are going to try to have the good recommendations adopted.

A word about cost. The survey cost $8197.61. As an offset, take a single instance of saving effected. Voluntarily, the Board of Fire Commissioners, through their secretary, notified us that they had abolished certain unnecessary positions and apparatus recommended for abolishment in the Fire Department, thus effecting an annual saving of $23,055.63. In itself this one saving covered much more than twice the cost of the survey and resulted in the transfer of about $15,000 from salaries fund to pay a part of the cost of motorization.

It is estimated that the cost of maintaining the bureau efficiently will be $20,000 per year. The citizens of San Francisco have already assured the bureau that income for the next five years. It seems to be a very moderate cost. One of the trustees of the Crocker Bank has mentioned that it cost $10,000 a year to audit that one bank, and $20,000 seemed a small amount for the City of San Francisco.

I believe that we will more than save to the City of San Francisco this annual cost every month that the bureau operates.

Finally, let me say, that this whole work may be summed up in the words—municipal thrift. The time has come when San Francisco, to go ahead in successful competition with the other cities of the world, must become thrifty in its public business. Help along this work by letting it be understood that you are behind it asd strongly for it.

THE BIENNIAL REPORT OF CITY LIGHTING AT SEATTLE.

In a recently published booklet of eighty-six pages entitled "City Light," which contains the biennial report of the lighting department of Seattle, Wash., the following interesting statement of expense and revenue for the six months ending June 30, 1916, is to be found:

This statement is made subject to adjustments at the end of the fiscal year, December 31, 1916.

Revenues.

Business	$155,681.38	
Residence	236,452.10	
Power, alternating current	69,995.46	
Domestic power	5,976.60	
Power, direct current	7,415.45	
Power, direct current, street railway	6,572.44	
Street lighting	119,220.86	
Gross operating revenue		$601,314.29

Expenses.

Operating and maintenance	$229,885.83	
Operating and interest, bonds	49,512.50	
Gross operating expenses		279,398.33
Net operating revenues		$321,915.96
Depreciation		114,155.82
Surplus, devoted to Redemption of bonds, payment of construction interest and to construction		$207,760.14
Vouchered in favor of general fund for construction interest	$33,750.00	
Vouchered in favor of sinking fund	29,700.00	
Vouchered in favor of redemption fund	10,500.00	
		73,950.00
Net surplus for construction		$133,810.14

TRADE RELATIONS WITH JAPAN

BY JIUJI G. KASAI, A.M.

(This excellent paper deals with the very delicate situation of friendly commercial and engineering relations between Japan and the United States. The arguments presented deal in sound facts and should immeasurably forward the traditions of peace that have so long bound the two nations together. The paper as a whole was delivered before a recent meeting of the San Francisco Electrical Development & Jovian League at the Palace Hotel.—The Editor.)

Transportation Methods in Japan.

DURING my long residence in your country, as a student of American institutions, I have travelled from the Pacific to the Atlantic, and having seen your wonderful land with vast resources, I have come to my firm convictions that the invincible spirit of the American people has made America the foremost among the nations. I have gone to Mt. Vernon to pay my own and my countrymen's homage to the memory of the "Father of His Country"; I have visited Valley Forge to remember the heroic deeds of the valiant soldiers of the American Revolution; again I have journeyed to New England to pay my veneration to those gallant minute men who embattled at Bunker Hill and who sacrificed their lives at Lexington and Concord.

When I think back the history of the wonderful growth of your nation in its westward course from the time of the Revolution, I am filled with wonder and admiration. Today this wonderful United States has her territories stretched to the Pacific Ocean and her dominion extended across the seas. Today the international relations between the United States and Japan have become much closer than in the past, and our two nations are going to play their important roles upon the stage of the twentieth century. As a student of international affairs with his ardent desire for the maintenance of the friendly relations between the United States and Japan, I wish to speak candidly and without reserve just as I would to my intimate friends.

Sixty-three years ago your gallant Commodore Perry awakened the secluded Empire of the Rising Sun with the booming of cannon and introduced her to the nations of the West. From that time on, the United States befriended Japan against the perils of foreign aggression, and Japan in turn has revered America as her teacher and true friend. In reviewing the romantic history of the international intercourse, between Japan and the United States, it is especially interesting for those of us in California to recall President Fillmore's message to the Emperor of Japan. The message read in part:

"Our State of California, produces about sixty millions of dollars in gold every year, besides silver, quicksilver, precious stones, and many other valuable articles. . . . . I am desirous that our two countries should trade with each other. . . . I have directed Commodore Perry to mention another thing to your Imperial Majesty. Many of our ships pass every year from California to China; and great numbers of our people pursue the whale fishery near the shores of Japan. It sometimes happens, in stormy weather, that one of our ships is wrecked on your Imperial Majesty's shores. In all such cases we ask, and expect, that our unfortunate people should be treated with kindness, and that their property should be protected, till we can send a vessel and bring them away. We are very much in earnest in this."

Thus, the growing commerce and industry of California led the government of the United States to force open the doors of the Japanese Empire.

California Hostile but Japan Amicable.

When a decade ago Japan fought in the titanic struggle against Russia, the American people gave us hearty sympathy and moral support. But hardly had we fulfilled the hopes and expectations of the liberty-loving American people when suddenly there appeared fears and suspicion of Japan in this country. California, for whose prosperity and commercial interest the sealed gates of Japan were opened, now turned to be a provacateur to threaten the historic friendship of of our two countries which had existed for the last half century. When, in 1907, our friendly relations were disturbed by the San Francisco school question, Japan tried her utmost to preserve the amicable relations with the United States. In order to avoid any future complications the Japanese government entered with the government at Washington into the "gentleman's agreement." Since then the Japanese government has been stringently observing the agreement, and has strictly forbidden emigration to this country. During the last eight years, Japanese immigration into the United States practically ceased, while many Japanese returned home from America. Consequently, the Japanese population in the United States has decreased in considerable numbers. Therefore, the so-called "Japanese menace" has remained merely as a bogey of alarmists, agitators and yellow journalists Since then the whole Japanese nation has been in earnest for the maintenance of the amicable relations with your country. The passage of anti-alien land legislation in California in 1913, therefore, caused a mingled feeling of indignation and disappointment of the Japanese people as well as among American friends of justice and righteousness. But, the Japanese people have preserved their characteristic patience and forbearance and trusted in the wisdom and sense of justice of the American people, firmly believing that you would give them a more humane treatment in the future. We are hoping that you will come to understand our true aims and aspirations as a nation, and

will realize the contributions made by Japanese farmers in California to the American life by converting arid lands into prosperous vineyards and turning marshes of the Sacramento and San Joaquin rivers into fertile lands for potatoes and vegetables.

Japan is Peaceful and Respects America's Monroe Doctrine.

Japan has never entertained the idea of American invasion as has been imagined by alarmists in this country. On the contrary, she is ever peaceful and friendly toward the United States. She respects the Monroe Doctrine,—the guiding principle of your foreign policy. She has never entertained any territorial ambition in the Western hemisphere. Her dominant desire is to see a strong China, capable of maintaining her own independence and sovereignty, which will naturally result in the peace and security of the Orient.

American-Japanese Trade is the Strongest Bond of Friendship Between the Two Nations.

Many of Japan's detractors view the rise of Japan as a menace to the American interests in the Orient. But, instead of being your "dangerous competitor," Japan has proved herself to be a boon of American commercial prosperity in the Far East.

The Japanese Parliament Building at Tokyo, where Friendly Foreign Relationships are Evolved.

Since Japan became a world power your Oriental trade has been constantly increasing, and our mutual commercial ties are being strengthened every year. The greater Japanese industries grow the greater will be the American commerce with Japan. In 1886, the trade between Japan and the United States, amounted to less than $10,000,000, while today it has reached to $150,000,000. The growth of the American-Japanese commerce has been very rapid in recent years. According to the Annual Report of Commerce and Navigation of the United States, in 1915 your imports from Japan amounted to $98,882,638, while your exports to Japan reached $41,517,780. Thus the total foreign trade of the United States with Japan in 1915 amounted to $140,500,418. Furthermore, due to the European war, the Japanese-American trade increased tremendously in the fiscal year of 1916, and imports from Japan amounted to $147,644,228. (The total figure of American exports to Japan in 1916 is still unknown). The United States has imported from Japan the articles which have been indispensable to her industries while she has exported to Japan those which the latter country has needed for her industrial expansion. The principal articles of the American-Japanese trade in 1916 are as follows:

Imports to U. S. from Japan.		Imports to Japan from U. S.	
Raw silk	$88,057,600	Cotton	$31,951,722
Silk goods	6,100,536	Kerosene	2,502,360
Tea	8,975,993	Steel plates	2,769,173
Bean oil	3,749,580	Tin	2,315,506
Copper	3,087,692		
China wares	1,268,651		

The United States imposes a very high tariff upon manufactured silks, while she allows raw silk to come in free to be turned into fabrics in American mills in Patterson, N. J., or in other textile centers in the East. As a result of the present war Japanese manufacturers who had hitherto bought machineries from Germany, England and France, commenced to buy from the United States, and the American exports to Japan is expected to grow in the future.

While American-Japanese Trade Grows, American-Chinese Trade Decreases.

While the American-Japanese trade has been growing in wonderful rapidity as has been described above, the American-Chinese trade has been rather declining. In 1911, the American imports from China amounted to $34,227,503, which rose to $40,156,139 in 1915; while the American exports to China which amounted to $19,287,836 in 1911, decreased to $16,402,475 in 1915. Thus, the value of American-Chinese trade of 1915 was $56,558,614, which is about one-third of the American-Japanese trade of the same year.

Charges that Japan Tries to Throttle the American Commerce in the Orient Are Absolutely False.

It has been charged that Japan has been trying to throttle the American commerce in the Orient. But, statistics speak eloquently that wherever Japanese influence extended, there American trade prospers. This is clearly shown in Chosen (Korea). Before the advent of Japanese administration in Chosen, American trade with the Hermit Kingdom amounted to almost next to nothing. In 1903, the American exports to Korea amounted to $199,188, but in the following year, when Japan took hold of the rein of government of the kingdom, it immediately jumped to $906,058. Since then American exports to Chosen have been increasng gradually while imports decreased almost to nothing. Thus, in 1915 American exports to Chosen amounted to $1,188,444, while imports amounted to only $8753.

The similar increase has been found in the American trade in Manchuria. Yet, charges have been made frequently that the Japanese government tried to defeat the American commerce in Manchuria by means of unfair rate regulations against American shippers. But, the Japanese government has never shown special favors to its nationals as against the interests of foreign shippers. If American cotton sheetings have been driven out of the Manchurian market, it was solely due to the competition of Japanese spinners who won over American manufacturers with their better banking and trading facilities, and more accurate knowledge of the needs, customs and language of their customers than their American competitors. In this connection, we must remember that although American cotton manufacturers of Lowell, Lynn and Lawrence might have lost their trade in Manchuria, yet

American cotton growers in Texas, Louisiana, Mississippi and Alabama and other Southern States have found the increasingly profitable market in Japan for their cotton crop. Moreover, when in 1909 the Japanese Honorary Commercial Commission visited the United States, Baron Shibusawa and other leading members of the party advised their California friends to plant sea-island cotton in the Imperial Valley, so that Japanese cotton mills would buy the entire crop. Today, the cotton growers of your Imperial Valley have found a very profitable market in Japan for their crops.

Trade.

It has been charged that the Japanese merchant marine is a menace to the American commerce on the Pacific Ocean. On the contrary, it has been a great blessing to American merchants and shippers. When a few months ago the scarcity of bottoms was felt on the Pacific, American shippers could not secure space for their cargoes even at $40 per ton, and their freights were piled up in Seattle and San Francisco awaiting for shipment. It was the Japanese merchant marine—regular liners and tramps—which made possible to relieve this congestion, and carried American manufactures to the Orient and Asiatic Russia at lower rates than were prevailing at the time.

Again, it has been charged that the competition of big Japanese firms has been a menace to American foreign trade. On the contrary, many Japanese firms with good banking facilities and branches abroad, are facilitating America's foreign trade. The best example can be found in the Mitsui & Company, Ltd,—one of the largest mercantile houses in the world. While the company, with its branch offices in San Francisco, Portland, Seattle and New York, is engaged in importing merchandise from the Orient, at the same time it is seeking to find markets abroad for American products. A few concrete examples suffice to illustrate this point. The San Francisco branch of Mitsui & Co. ships California products, such as grains, lumber, fruits, not only to Japan but also to Latin America and Europe, with its own steamers. Thus, though a Japanese company in name, yet it is serving American foreign trade just as faithfully and efficiently as American concerns can.

The Steamship China—A Well-known Transpacific Medium of Commercial Relations.

Electrical Industries in Japan.

I have thus far discussed the trade relations between the United States and Japan. Now let me tell you briefly about the electrical industries of Japan in which you might have your special and professional interest. In the last few years wonderful strides have been made in electrical enterprises in Japan. Since Japan is a mountainous country with an abundant supply of waterpower that can be adequately harnessed, she is destined to be a great industrial nation. According to a statement issued by the Department of Communication, July, 1916, there were 637 electrical enterprises in the Empire with a combined capital of $306,278,711. Of those, 16 were new plants built within the last year, with a total capital of $1,464,308. Of the total number of electrical concerns above mentioned, 550 are power-suppliers with a combined capital of $150,003,177, 42 are electric railway concerns with a total capital of $15,947,500, while the remaining 46 concerns are doing two sorts of business combined with a total capital of $140,328,035. Besides these, the Tokyo Electric Light Company recently decided to construct a new plant on the Chickumagawa River at the cost of $7,500,000.

The Partnership of Japanese and American Companies is Successful and Desirable.

In this connection it may not be amiss to tell you of the very intimate relationship that has existed between the electrical industries of Japan and of the United States. Again, mention may be made of Mitsui & Company. Many years ago, the company became the sole agent of General Electric Company in the Orient, and introduced into Japan everything made by the American concern. At the same time, electrical manufactures were introduced into Japan from England, Germany and France. But, the enterprise of Mitsui & Company gradually won for the American company its commercial supremacy in Japan. Meanwhile, there grew a native electrical company named the Shibaura Engineering Works, and its competition was began to be felt by the General Electric Company. At this moment, through the mediation of Mitsui & Company, the merger was completed between the Shibaura Engineering Works and General Electric Company. Today, the Shibaura Engineering Works are conducted by the joint supervision of the American and Japanese engineers, and profits are shared by the American and Japanese shareholders. Now, there appeared in Japan a rival company of Mitsui & Company in Takata & Company, representing the Westinghouse Electric & Manufacturing Company. Thus, we find that the electrical world of Japan is divided into two American camps, namely the General Electric Company and the Westinghouse Electric & Manufacturing Company. Then again, there is the Nippon Denki Kaisha (Japan Electric Co.), of Tokio, with which the Western Electric Company has formed a partnership. I understand that the Western Electric Company is still supplying telephone apparatus for Japan, and shares profits with the Japanese company. Today, due to the European war, the imports of the electrical machines and motors from England, Germany and France

have practically ceased, and the American electrical concerns hold their supremacy in Japan.

The success of these two American concerns in Japan has been largely due to the ability of their Japanese agents and partners, and it bespeaks so eloquently the integrity and trustworthiness of Japanese businessmen. Such instances as these put to shame those mischievous myth-makers who are continuously spreading ridiculous lies that the Japanese are so dishonest that they cannot trust even their own countrymen, and consequently employ Chinese cashiers in Japanese banks, and that Chinese merchants are more honest and reliable than Japanese, etc.

The Commercial Interdependence of the United States and Japan Should Serve to Prevent War.

Before concluding, let me repeat again that the commercial relations of our two countries which have been growing in intimacy should serve to strengthen the bond of friendship between the two peoples. Our commercial interdependence should be a sufficient guarantee against war. Take for instance an average citizen of Japan. He rises in the morning from his bed covered with sheets made of American cotton from Texas; he eats fruits from California and meat from packing houses of San Francisco or Chicago. His home is built with lumber from Washington and Oregon, and at night, his home is lighted with kerosene from California or Pennsylvania, and electric lamps from Schenectady or Pittsburgh. Our industrial plants are equipped with American motors and engines, and our railways are built with steel rails from South Chicago or Pittsburgh on which Baldwin engines draw Pullman cars. On the other hand, the United States is the biggest customer of Japan. Eighty per cent of silk and sixty per cent of tea imported by your country comes from Japan. Thus, your wives and daughters decorate your homes with Japanese art, and they dress themselves with the silk spun by the nimble fingers of Japanese girls; they entertain their friends with the tea picked upon the green hillsides of my native Japan; and your children are blessed by Santa Claus with dolls and toys made in Nippon. Fine and delicate is the thread of silk, yet it binds our two great nations.

Last summer, when Judge Elbert H. Gary, president of the United States Steel Corporation visited Japan, he was loyally welcomed by captains of industry and high officials of the government and the people in general. He was given an enthusiastic ovation wherever he went in Japan, because he is an influential American citizen. In the banquet given in his honor by our leading financiers and statesmen at the Imperial Hotel, Tokio, on September 5, Judge Gary said in part:

"I am here to say to you and to all your friends throughout Japan with all the emphasis that words can express, that the business men of the United States, with whom I am in close and intimate contact, do not look for trouble between the United States and Japan, now or hereafter. They would stubbornly oppose any suggestion of conflict between those great nations with all the force and influence in their command; and this is undoubtedly the prevailing and controlling sentiment of the citizens generally throughout the United States."

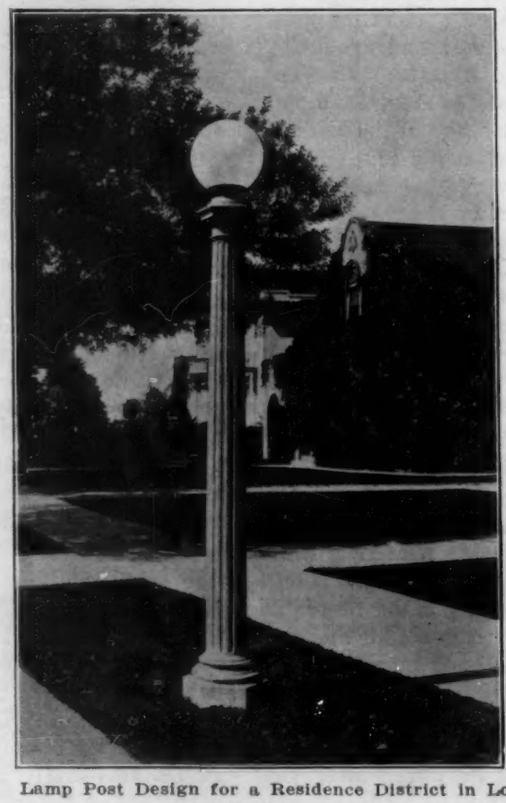
This frank statement of Judge Gary eloquently expressed the sentiment in the innermost hearts of the sixty million of my countrymen toward you, the American people. I sincerely hope that he has given expression to your controlling sentiment towards Japan. Thus may our two peoples grow in mutual understanding and respect which alone can bring international peace and concord. Thus may our flags,—the glorious Stars and Stripes and the emblem of the Rising Sun,—be the joint guardians of peace on both shores of the Pacific Ocean.

RESIDENCE LIGHTING IN LOS ANGELES.

Typical of recent evolution in street lighting, the beautiful Wilshire Boulevard, in the residence district of Los Angeles, is being adorned with the single lamp

The Wilshire Boulevard in Los Angeles.

standards of the type illustrated. The lamps constitute striking evidence of the growth of the artistic spirit in street lighting.



Lamp Post Design for a Residence District in Los Angeles.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING.

(The data published in this department should be of great value to all interested in the important subject of utilization of electric power for irrigation pumping. A number of power companies and engineers of the West are co-operating with the author in the gathering of the very latest experimental material for its columns.—The Editor.)

Canal Erosion Increases the Seepage Loss.

The Seepage Loss from Field Ditches is High.

Long Furrows Give Excessive Percolation Loss.

REPLENISHMENT OF GROUND WATER FROM IRRIGATION.

The usual or natural source of ground water is the percolation of precipitation directly through the soil or from the seepage loss from stream beds. These may be artificially increased in amount by preparing the soil so that a larger portion of the precipitation will be absorbed or by spreading the stream flow over adjacent porous lands in order to increase the seepage.

There is another source of ground water which may be of much assistance in replenishing the supply for irrigation pumping. This is the deep percolation of a part of the water applied in irrigation. In many cases the amount of such deep percolaton of irrigation water has exceeded the capacity of the underground drainage and the water table has risen until the water logging of lower areas has resulted.

In the majority of areas irrigated from gravity supplies, pumping within the irrigated area is not usual, all the water used being secured from the gravity systems. In some cases, however, particularly in California, the supply available from direct diversion, becomes deficient during the later portion of the growing season and pumping to supplement the gravity supply may be practiced for some crops. Also within the area covered by the canals may be many farms which do not have rights to canal water but depend entirely on pumping. That the bringing in of canal water is a material benefit to the person depending on pumping is now recognized by the California Irrigation District law. In irrigation districts, lands within the district which have secured their entire supply by pumping from the ground water are required to pay district assessments for bond interest and principal which generally represent the construction cost. No assessments are levied against such lands for operation and maintenance of the canal system if the operation of the pumping plant is continued.

Part of the water diverted by a canal may reach the ground water either by direct seepage from the canal or by deep percolation of a portion of the water applied to the fields. Such waters after reaching the ground water may be carried off by the underground drainage or if too large an amount may raise the height of the ground water plane until sufficient area and pressure are secured to carry off the water that is being received. If such additions are too large in amount the ground water plane may reach the surface in the lower lands. As the water added to the ground water at different times of the year varies, the water plane will also fluctuate. Ground water is subject to the same laws of flow as other waters and is always found moving under the influence of the slope of its surface, the rate of its movement, however, being usually very small.

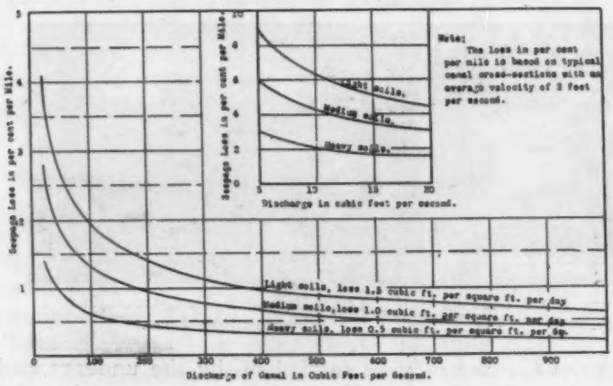
The seepage from earth canals depends mainly upon the character and extent of the wetted surface in the canal section. This may be either the original ground as excavated for the canal or as modified by deposit or erosion. Other factors which affect the rate of seepage are the temperature, velocity, form of cross-section and height of ground water in the adjacent soil.

Canal seepage can be expressed either in terms of percentage loss per mile of the total flow or as the loss in cubic feet per square foot of wetted area per 24 hours. Much data regarding measurements of canal seepage have been published in various bulletins and technical magazines. In general it has been found that the rate of seepage averages about 0.5 foot in depth per 24 hours over the wetted area for impervious soils, such as clays and clay loams, 1.0 ft. for medium soils such as the lighter silt loams or fine sandy loams and 1.5 ft. for pervious soils such as the coarser sandy loams and sands. For gravelly soils the rate may be much higher.

The loss in per cent per mile will vary with the size of the canal. The proportion of the wetted area to the capacity is much larger in small cross sections. By assuming typical forms of cross section and average velocities the rates of loss per square foot of wetted area can be expressed as per cent loss per mile. In the figure given herewith may be found a set of curves that show the per cent loss per mile for different rates of seepage where canal velocities are assumed

as 2 ft. per second. These curves show the rapid decrease in percentage loss with the increase in size of the canal.

In estimating the amount of water added to the ground water from canal seepage, the total loss in the canal system is a more useful unit; the total proportion of the water diverted which is lost by canal seepage may vary from 10 to 50 per cent. The average for all systems operated in 1914 by the United States


Seepage Loss in per cent per Mile.
Discharge of Canal in Cubic Feet per Second.
Note:
The loss in per cent per mile is based on typical canal cross-sections with an average velocity of 2 feet per second.
Light soils.
Medium soils.
Heavy soils.
Discharge in cubic feet per second.
Light soils, loss 1.5 cubic ft. per square ft. per day
Medium soils, loss 1.0 cubic ft. per square ft. per day.
Heavy soils, loss 0.5 cubic ft. per square ft. per day.

Average Seepage Losses in Canals in Per Cent Per Mile.

Reclamation Service was 35 per cent. As these were relatively new systems, not irrigating the full areas under the canals, the percentage losses will probably decrease with the development of the projects. In canal systems lined with concrete the loss may be very materially reduced. It is not usual, however, to line the laterals for large areas, authough there are a few locations where this has been done.

The seepage losses from the canal system may not all reach the ground water within the area covered. Where long diversion canals are used, the seepage in the upper system may return directly to the stream. The losses in the lateral systems go most directly to the local ground water. There are not as many records available where the loss in laterals has been kept separately from the losses in the main canals as for the losses in systems as a whole. The usual lateral systems will generally have a seepage loss of from 10 to 15 per cent of the water diverted into the system. This loss is usually a direct addition to the ground water within the area irrigated.

There is another source of loss in irrigation which usually exceeds the seepage loss in the laterals, and in some cases exceeds the seepage loss in the entire canal system. This is the percolation through the soil of a part of the water applied to the fields. Under careful handling of the water this loss can be made quite small. Under many types of irrigation practice such deep percolation losses are a large proportion of the water received. The loss is invisible to the irrigator, who consequently fails to realize its amount.

Moisture is present in soil in three forms. A certain amount of moisture is so intimately associated with the soil grains that it cannot be removed by plants or by drying in air. This moisture, known as hygroscopic moisture, is of no use to the plants. Moisture also occurs as a fine film surrounding the soil particles. This film is retained against the action of gravity and distributes itself from one soil grain to another by what is called capillary attraction. The movement of capillary moisture is from the more moist soil to that which is more dry. Such movement may be laterally or vertically. The third type of moisture is that subject to the action of gravity. This is the moisture in excess of the other two types which moves downward through the soil pores.

When the film of capillary moisture around the soil particles becomes so thin that the plants have difficulty in securing a sufficient supply for their growth, irrigation should be applied. This results in filling the pores in the surface soil in contact with the irrigation water and supplying it with gravity moisture. This gravity moisture moves downward through the soil. As it moves the capillary moisture of the soil with which it comes in contact is replenished. There is also some lateral movement of the capillary moisture beyond the area directly supplied with gravity moisture as in furrow irrigation.

The aim in irrigation should be to apply a sufficient depth of water so that the capillary moisture will be replenished to the depth of soil used by the plant roots without having any excess to pass below such depths. Capillary moisture tends to move in all directions until equalized, and some moisture may pass downward in a soil without its having any gravity or free moisture present. Any water passing below the depth of plant use becomes a deep percolation loss.

It is not possible to add just the right amount of water to each portion of a field so that no deep percolation will occur. The relative amount of water received by any unit of the area of a field depends on the length of time it is in contact with the water. In flooding or furrow methods of irrigation the area adjacent to the turnout or head of the furrow receives water for a longer time than the portions at the lower end. In order to be reasonably certain of giving sufficient moisture to those portions of the field which are hardest to reach, it is usually necessary to apply some excess to other portions. The more carefully the field is prepared and the water applied, the less will be the difference between the maximum and minimum amounts used.

Even with good practice some of the water applied will pass beyond reach of the plant roots if an attempt to moisten the full root depth is made. With careless preparation of the land or handling of the water, such deep percolation may amount to a very considerable proportion of the water received at the field.

The difference between the minimum moisture to which it is good practice to allow a soil to become dried and the maximum which it can retain against gravity represents the maximum amount which should be applied at any irrigation.

In order to estimate the amount of such deep percolation losses, a knowledge of the moisture holding capacity of soils under field conditions is necessary. The results of a number of investigations on different soil types are now available, and much additional work is being done by several of the experiment stations.

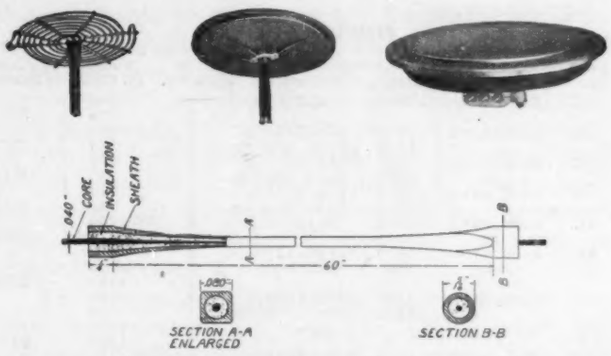
ELECTRIC COOKING AND HEATING

(Electric cooking and heating are the live issues of the electric power salesman. Education in modern electric appliances and their uses is the crying need of the hour. In this department the latest up-to-the-minute ideas along these lines will be published.—The Editor.)

TYPICAL ELECTRIC RANGE DESIGNS.

BY E. A. WILCOX.

Radiant Type Units.—These are usually coils of high resistance wire laid in grooves, or supported on the surface of insulating material. Current passing through this wire brings it to a high temperature, and the heat is transmitted for the most part as radiant heat direct to the utensil or the food to be cooked. Some of the heat, however, is absorbed by the insulating support and some is given off as convected heat both from the support and from the wire itself, the percentage



Process of Manufacture of General Electric Sheath Wire Heating Elements.

varying with the design of the unit and its composition. In a well designed unit much of this convected heat is finally taken up by the food.

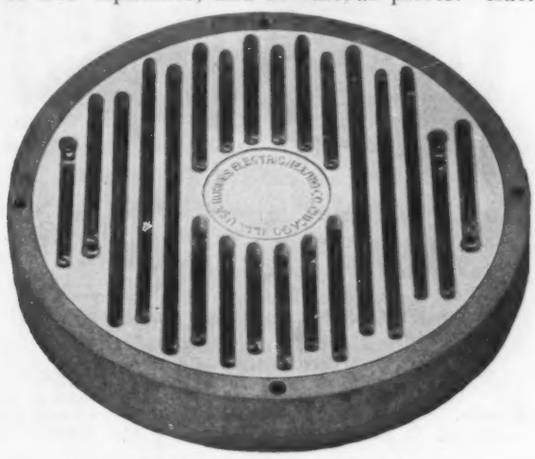
Radiant type units begin to throw off a large amount of heat almost as soon as the current is turned on. The heat in the coils, is visible on account of the high temperature. The nature of the radiant heat given off makes it possible to use the ordinary kitchen utensils to better advantage on the open than on the enclosed type elements. The coils being exposed, however, and the supports, as now manufactured, being somewhat brittle, this type of unit is to some extent liable to mechanical injury, short circuits, and grounds. It is also harder to keep clean than the enclosed type element.

Reflector Type Element.—Use is here made of the heat reflection principle. It usually consists of exposed coils of wire surrounded by air and supported adjacent to a bright metallic reflector. Part of the heat generated in the coils passes directly to the cooking utensil or to the food in the same manner as from the ordinary radiant type element. Another portion of the heat travels in the opposite direction until it reaches the polished surface, where it is reflected back on its course to the cooking utensil. A small percentage of the energy is, of course, given off as convected heat and some passes away through the reflector.

This type of element heats quickly, makes possible the use of most ordinary kitchen utensils, and produces a visible heat in the coils. It is, however, more subject to mechanical injury than the enclosed type element.. The reflectors, although they can be easily and cheaply replaced, are also likely to become discolored and become inefficient on account of the intense heat. The future development of a cool reflector, however, may do away with the latter objection.

Types of Electric Ranges.

A large variety of electric ranges are manufactured in this country. They are available in many styles and capacities, and at various prices. Each of



Hughes Open-Type Element.

them has been developed with certain individual characteristics in design or operating features, having some advantages over those of other makes, but all of which could not possibly be incorporated in any single design. This chapter is therefore devoted to descriptions of the most prominent makes of electric ranges in order to convey a general understanding of the design, construction and individual characteristics of the types now available.

Hughes Ranges.—This make of electric range has been on the market for a number of years. It is made in a large variety of shapes and sizes, in either the high oven, low oven, or cabinet types, and in capacities ranging from 4140 to 10,340 watts. The frame is constructed of black heavy gauge sheet metal supported on cast iron legs. The legs, top, and fittings are nickel finished in most of the designs. The general construction is rugged and of handsome appearance.

The heating elements are of the open or radiant type and consist of coils of resistance wire held in place below the cooking surface by means of a grooved composition block. This block is in turn, surrounded by another block of asbestos compound having high thermal resistance. The units may be easily removed with a screw driver and pliers.

The oven is thoroughly insulated with mineral wool. The interior of the oven is finished in black.

Thermometers are fitted in these doors. There are two heating elements in the oven—one in the top, and the other in the bottom. Each of these units is regulated by a three heat switch. The top unit is used for broiling. An enameled tray and rack for this purpose are provided with each range.

Hughes No. 50 Cabinet Range.

HUGHES RANGES.

No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
C-2	Cabinet	2-880	18x12x12	1	1500	
				1	880	4140
C-3	Cabinet	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
C-4	Cabinet	2-1100	18x18x12	1	1500	
				1	1100	
				1	880	5680
C-18	Low oven	2-880	18x12x12	1	1500	
				1	880	4140
No. 27	Low oven	2-880	18x12x12	1	1500	
				1	880	4140
No. 30	Low oven	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
No. 33	High oven	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
No. 37	Low oven	2-1100	18x18x12	1	1500	
				1	1100	
				1	880	5680
No. 40	Low oven	2-1100	18x18x12	1	1500	
				1	1100	
				2	880	6560
No. 44	High oven	2-1100	18x18x12	1	1500	
				1	1100	
				2	880	6560
No. 47	Cabinet	2-1100	18x18x12	1	1500	
		Warmer-	21¼x20x9	1	1100	
				1	880	5680
No. 48	Low oven	2-1100	18x18x12	1	1500	
				2	1100	
				3	880	8540
No. 50	Cabinet	2-1100	18x18x12	1	1500	
		Warmer-	21¼x20x9	1	1100	
				2	880	6560
No. 56	Cabinet	1-1800	18x18x8	1	1500	
		2-1100	18x18x12	1	1100	
		Warmer-	21¼x20x9	2	880	8360
No. 60	Cabinet	1-1800	18x18x8	1	1500	
		2-1100	18x18x12	2	1100	
		Warmer-	21¼x20x9	3	880	10340

Simplex Ranges.—These ranges were first put on the market about nineteen years ago. The modern domestic types usually consist of an oven, a broiler, and several disc heaters. They are made up in either the low oven, or cabinet type, and in capacities ranging from 3100 to 8200 watts.

The heating units are of the enclosed type, the resistance wires being embedded in enamel, and fused to the under side of the cast iron discs. The discs protrude slightly above the top of the range, and are provided with a simple locking device by which the utensils are clamped fast to the heating surface to insure good contact. The units are fastened to the frame with thumb screws.

The broiler is mounted on the cooking surface. It consists of a corrugated heating plate slightly inclined toward the front, from which an outlet carries off the juices for serving with the meat. A separate smooth top fits on the broiler for making griddle cakes, etc.

The oven is made of Russia iron with japan finished iron frame and nickel plated trimmings. The walls are heavily insulated with corrugated asbestos and provided with a vent. The heating elements in both top and bottom are of the enclosed grid type, and are controlled by a single three-heat switch. The oven door is of the drop shelf type, fitted with an indicating thermometer.

SIMPLEX RANGES.

No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
4K	Low oven	1300	15x12x11½	1	440	
				2	735	3210
5K	Low oven	1300	15x12x11½	1	440	
		1300	9x12 broiler	1	735	3775
6K	Low oven	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	4515
7K	Low oven	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	4810
8K	Low oven	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	5250
9K	Low oven	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
				1	1100	5910
14K	Low oven	2400	21½x19x13	1	440	
		2200	12x18 broiler	1	735	
				1	1100	
				1	1300	8175
21K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	
		200	15x15x7 warmer			4715
22K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer			5010
23K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer			5450
24K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer	1	1100	6110
31K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	4515
32K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	4810
33K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	5250
34K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
				1	1100	5910

Simplex No. 7-K Range.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(The electrical contractor and dealer are constantly running into perplexing problems of wiring installation, motor control and opertaion, window display, cost keeping and a thousand other hourly obstacles to business efficiency. This department is designed to meet just such needs. The author is apparatus specialist for the Western Electric Company.—The Editor.)

ALTERNATING CURRENT MOTOR TROUBLES

Low Voltage. Low voltage is probably the most frequent cause of motor trouble. This trouble may arise only during the starting period while the motor is drawing a heavy starting current or it may appear after the motor is started and is carrying its load. In this latter instance, if the voltage is considerably below normal the motor may not be able to carry its full load or will heat excessively.

Low voltage may be due to a number of causes. When referred to motors of five horsepower or less, which are usually started by being thrown directly across the line at full voltage, it invariably results from excessive line drop due to insufficient conductor capacity, that is, wires that are too small. Complaints of this kind are rather limited because these small motors are not generally required to start under heavy load and will run up to speed at a voltage considerably below normal. However, cases of excessive temperature rise are frequently traced to low voltage.

In connection with larger motors requiring a starting compensator, a wrong tap in the latter may not allow sufficient voltage at the motor terminals when the handle is thrown to the starting position. The motor may not start or it may start slowly but will not run up to speed. This depends on the starting torque required for the load. Some apparatus require the maximum torque at starting, with the torque falling off as the speed increases. The motor will then be likely to attain full speed if it starts at all. A good example is a line shaft with numerous hangers and driving pulleys.

On the other hand, some machinery—a blower fan for example—requires considerable more power as the speed increases. Thus, the motor may start but usually cannot attain more than a fraction of its normal speed. The remedy in such cases is simply in using the proper voltage tap.

Compensators are usually connected for the second lowest starting voltage and torque before shipment. If the motor will not start its load promptly with the compensator connected as received, the next higher voltage taps should be tried and so on until taps are found that will give the required torque. Should the motor not start wth the compensator arranged for the highest voltage, the remedy is to provide a larger motor or one that will develop larger torque. This may call for a phase-wound or slip-ring motor.

With these larger motors the trouble may also result from the heavy voltage drop in the supply circuit as already mentioned or may be caused by overloaded transformers. It is now almost universal practice to provide leads which have a normal carrying capacity 50 per cent greater than the full load amperes of the motor. In most cases this size of wire will be found ample provided the distance of transmission is not too great. With wires selected on this basis the limit of distance is about 590 ft. for 220 volt circuits or about 1075 ft. for 440 volt circuits. Up to these distances the voltage drop will not exceed 5 per cent, which is about the maximum to be recommended for such circuits. This is true for either two or three-phase circuits. Greater distances require larger sizes of wire to avoid excessive voltage drop and its attendant results.

In the isolated plant low voltage is sometimes the result of poor voltage regulation in the generator. By voltage regulation is meant the percentage rise in voltage between full load and no load. This percentage of regulation depends upon the design of the generator and nature of the load. It is particularly affected by loads of low power factor, such as induction motors.

The tendency of the present day is towards small motors and individual drive on account of its many advantages, so if care is not observed to properly fit each motor to its load there is likely to be a number of partially loaded motors producing a general load of low power factor. Should this resulting power factor be lower than that for which the generator has been designed and guaranteed it will be impossible to maintain normal voltage.

This, however, is not the only objectionable effect of low power factor. It will also produce increased losses and poor regulation in the lines, decreased generator capacity, increased heating, in fact, is responsible for a whole string of ill effects.

The remedy when such conditions exist is to rearrange the load so that each motor will operate at practically full load and further to avoid operating a number of motors idle or under light load. If this is not possible, then the only remaining remedy is to provide a machine to neutralize the inductive effect of the load. Such a machine is technically known as a synchronous condenser. Synchronous motors are also of value for this same purpose to a limited extent.

Again there may be certain applications demanding heavy starting torque and if the starting torque of the motor provided is at the best only sufficient to give the results, it is then very essential to keep the generator voltage up to normal. When the load is started frequently this requires much attention from the operator and a far more satisfactory method is to install an automatic voltage regulator. This device holds the voltage practically constant at all loads by control of the exciter voltage. This question of regulation has been covered quite in detail because it is not fully appreciated by many of our readers.

The general effect of the large starting current required by squirrel-cage induction motors upon the voltage regulation of an alternating current generator is outlined in the experience of a large manufacturing plant which had just been remodeled to use the individual motor drive. A number of motors ranging in sizes up to 75 h.p. had been installed. These were supplied with energy from a 325 k.v.a. 480 volt three-phase generator placed in the power house some several hundred feet away and connected to the plant by a transmission line operating at the generator voltage.

One of the motors, a 75 h.p. machine with squirrel-cage rotor was direct connected to a double band saw which, even under the most favorable conditions, required a very heavy torque at starting.

This machine had previously been operated from a long line shaft with the usual belt equipment and during the time the change was made to individual motor drive, the machine had been thoroughly overhauled. New bearings were supplied, also a new belt. On account of these changes the machine started much heavier than it would ordinarily do after having been in operation regularly for sometime.

When this equipment was tried for the first time there was trouble right away. The compensator was connected for the next to the highest voltage and when thrown to its starting position caused the motor to draw a heavy current. This immediately re-acted upon the generator causing its voltage to fall from 480 down to about 325. At this low voltage the motor would, of course, not start and in a few seconds the line fuses would blow.

This same performance was repeated several times not only with this particular motor but with several others driving different machines. The result was similar and finally the owner appealed to the manufacturer who supplied the equipment saying that there was something radically wrong.

A few more trials by the manufacturers representative soon pointed out the cause. The engineer at the power house had paid absolutely no attention to the generator and consequently the voltage fell very low during the time these large motors were started. The engineer at the power house was stationed at the switchboard and told just how to manipulate the field rheostat when the motors were thrown on as indicated by the switchboard ammeters. The voltage was by this means maintained at about normal and after several trials the large motor driving the saw was able to start its load within reasonable time. Later on, the belts were loosened, and as the bearings wore down a little the difficulty was not again experienced.

This trouble was entirely eliminated after installing an automatic voltage regulator which had been ordered with the generator but not received up to the time the experience just related happened.

The ordinary type of a squirrel-cage motor is not well adapted for starting loads of this kind and it would have been better practice to have provided a motor of the phase-wound type giving a much higher starting torque and at the same time drawing a smaller starting current.

This particular instance further illustrates the marked effect of starting a large motor from a generator of comparatively small capacity.

Motor Nameplate Incorrectly Marked.

Once in a great while a motor will be found with a nameplate incorrectly marked. If the motor is wound for a voltage higher than that indicated on the nameplate, the action at starting will be the same as due to any other cause of low voltage but more marked on account of the considerable difference between standard voltages for motors. For example, a motor wound for 220 volts but marked 110 volts, would be able to develop only ¼ of its maximum starting torque, even if started at full line voltage. Looking at it in another way, a 5 h.p. 220-volt motor on a 110-volt circuit would have operating characteristics similar to those of a motor ¼ its capacity or 1¼ h.p.

Conversely, the nameplate may be marked for a voltage higher than that for which the motor is designed. In this case the motor will draw a heavy starting current and the fuses will blow almost immediately after the starting switch is closed.

When started by means of a compensator, however, a motor so marked will probably not blow the fuses until the compensator handle is moved to its running position, giving full voltage across the motor terminals because with the handle in the starting position the voltage received from the compensator is considerably less than full voltage.

These errors in marking are not common but are often troublesome because they are difficult to check unless the winding specifications for the particular machine are available.

As an example of incorrect nameplate stamping at the factory, the following experience is of value. A squirrel-cage motor rated 20 h.p. at 440 volts was belted to a wood working machine, being controlled by the usual form of starting compensator with fuse panel for overload protection. The motor started promptly with the compensator lever in the starting position but when the lever was transferred to the running position, the fuses burned out immediately. The fuses were replaced and another trial made but with the same results.

The belt was then removed and the same performance followed with the motor running unloaded. The action was just the same, the fuses on the panel blowing out almost immediately upon placing the starting compensator lever in the running position.

The compensator was tested and found to be without defects. The taps on the various coils were in correct position and the voltages between leads with compensator lever both in running and starting positions were correct and equal across all phases. Inspection of the winding of the motor indicated it to be in good condition. Further tests proved this to be a 220 volt motor incorrectly marked for 440 volts. The motor was replaced by one with correct winding.

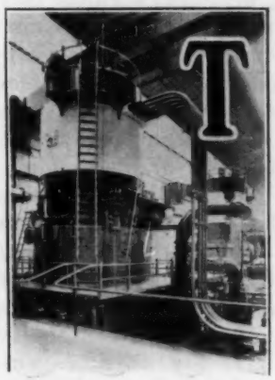
Some time later a similar experience came up in connection with an 18 in. ventilating fan of the direct connected type. The fan would not come up to speed and after several trials it was found to be a 220 volt motor on a 110 volt circuit, although the nameplate indicated it as being a 110 volt machine. In this case the winding was re-connected for the proper voltage.

FUEL OIL AND STEAM ENGINEERING

(Fuel oil and steam engineering are today receiving an immense impetus in the West. The new shipbuilding, combined with a normal activity in steam auxiliary design, call for up-to-date educative knowledge along these lines. This series is written so as to be devoid of higher mathematics. Readers of the Journal who desire to follow these articles as a course of study may do so by applying to the Extension Division of the University of California, where by the payment of a small fee, a series of questions and answers with problems illustrating the text may be acquired.—The Editor.)

THE MODERN POWER PLANT FOR FUEL OIL CONSUMPTION.

BY ROBERT SIBLEY.



A 20,000 h.p. Curtis Turbine Installed in San Francisco.

THE enormous growth of the electrical industry throughout the world during the past decade has entirely revolutionized methods of power development. Especially is this true west of the Rocky Mountains, where gigantic natural water powers have been put to a useful purpose. Owing to the fact, however, that most of the western streams show a great variation in flow in the different seasons of the year, it is not always possible to depend solely upon waterpower for the supply of electrical energy. In recent years the advent of crude petroleum upon the Pacific Coast, representing a total in production of over one hundred million barrels, has made it possible when rainfall or water supply is lacking to economically supply the needed power. During certain hours of the day, too, when the so-called peak load conditions are to be met by a central station, additional electrical energy over that possible to supply from the hydroelectric station is found to be necessary. Hence, the steam power plant, consisting of large concentrated units, is now recognized as an indispensable auxiliary to continuity of service.

In order that there should be no excessive loss in distribution, these concentrated steam power units are usually found in the heart of the great distribution centers. Especially is this true where abundance of circulating or cooling water may be obtained. Thus we find in Central California, Station A and Station C of the Pacific Gas & Electric Company, and the Fruitvale Station of the Southern Pacific Company, all situated in the distributing centers of San Francisco and its immediate vicinity. In Los Angeles we find that the Redondo Plant of the Pacific Light & Power Corporation and the Long Beach Plant of the Southern California Edison Company, owing to the lack of abundant cooling water near the distribution center are situated at a distance from it of some fifteen or twenty miles.

It will now be interesting and instructive to examine the details of a typical power installation of the sort just hinted at.

First, we shall describe the socalled steam cycle, or the journey of the steam-making water from the time it enters the steam boiler until it has passed through the turbine, or power unit, and returned again to the boiler; secondly, we shall consider the circulating water which is necessary in large quantities to convert the exhaust steam back again into water; and thirdly, we shall also touch briefly upon the journey of the oil from the time it leaves the cars at the sidetrack until it disappears from the chimney as a flue gas. We shall also touch briefly upon the general size and functions of apparatus employed to accomplish these results.

The Steam Cycle.

The Storage Tank. The supply of water for steaming purposes is usually brought to a make-up or storage tank from supply wells either on the immediate premises or nearby property. If these are not found, it is brought from rivers, lakes, or other bodies in the vicinity, or in many cases is purchased from some water company supplying the municipality. The storage tanks are varied in size, shape and capacity from a small tank, used as a receiver and hot-well, to a number of tanks, large and small, used for storage purpose only.

The use of storage tanks depends upon the source and quantity of water supplied and the load carried by the plant. Where there is a steady and positive source of supply, the tank may be of small capacity. In some cases where the supply is small and the storage at different periods is unfit for use, larger storage and settling tanks are required, and at times even filtration and cleaning tanks also are employed.

Pumps for Storage Supply. The tanks above alluded to are filled either by pumps, gravitation flow, syphons, or piping from a water company's main. There seems to be no standard type of pump. Both reciprocating and rotary appear in standard practice. On the other hand, many plants have wells and water is lifted by air pressure. This, on account of the total absence of working parts, is particularly useful, where there are a number of scattered wells, and, also, when it becomes necessary to handle dirty water, that is,

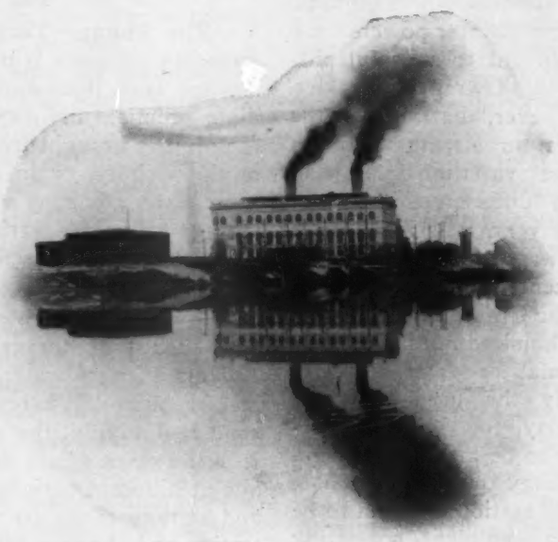
Measuring and Purifying Tank for Water Supply at Redondo Plant.

water containing sand, grit, and dirt in suspension. This air lift consists of a partially submerged water pipe and an air supply pipe. The casing of the well is driven below the lift pipe. The lift pipe is set in the well either with air surrounding it between the pipe and the casing or with a cap over the casing, making the space in the casing air-tight. In some instances the well casing is used directly as the lift pipe.

The Hot-Well. The water from the storage tanks is either pumped or is caused to flow by gravity to a socalled hot-well. The hot-well is a tank which stores the water before it passes to the feed-water heater. It receives water from the condenser and admits an additional supply from the storage tanks to meet the needs of steam generation.

Feed-Water Pumps. From the hot-well, water is taken through feed-water pumps into the feed-water heater. The function of a feed-water heater is to heat the entering water to a temperature approximating that of evaporating conditions in order to keep the boiler at as even a temperature as possible and at the same time to put the exhaust steam from the auxiliary apparatus to some useful purpose.

Feed - Water Heaters. These are divided into two general types: open and closed. In the open heater the steam comes in direct contact with the cooling water, and if there is a sufficient quantity of steam, it raises the water to 212 deg. F., the excess steam passing to the atmosphere. In a closed heater, on the other hand, the water is not exposed to the air and, if necessary, can be raised to boiler temperature. The water from a closed heater is as a rule much cleaner, since at high temperatures the deposits and minerals in solution are precipitated



The Redondo Power Plant of the Pacific Light & Power Corporation, With Oil Storage Tanks.

In steam plants where closed feed-water heaters are used, the boiler feed pumps are placed before the heater, thus pumping through the heater to the boiler. When open feed-water heaters are used, however, the boiler feed pumps are placed between the heater and the boiler.

Economizers. Economizers are sometimes installed in place of feed-water heaters. The economizer is a series of pipes through which the feed-water passes, placed in the path of escaping gases from the boiler furnace.

The Boiler. The boiler next receives the water from these heaters and converts it into steam at the desired pressure and temperature. The main types of boilers are water and fire tube. Modern practice indicates a decided preference for water tube boilers. A water tube boiler consists of steam and water drums placed on the top and a mud drum placed below, the two being connected by a series of tubes filled with water or steam. The fire is below these tubes, and the heat from the furnace is made to pass around them several times by means of headers or partitions, thus supplying heat for steam generation.

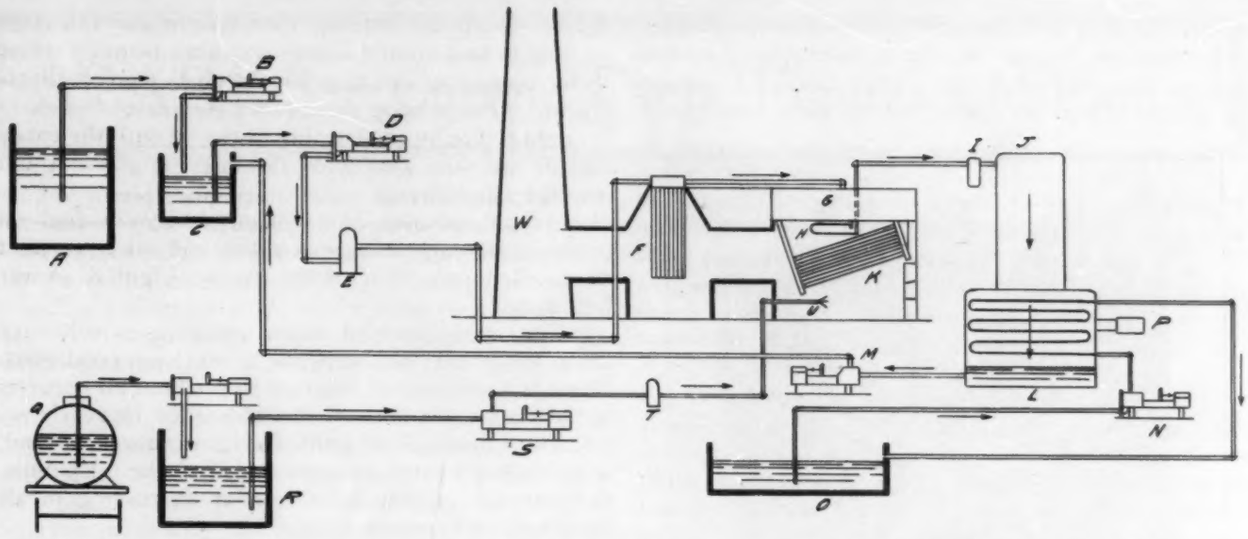
The Superheater. The water being thus converted into saturated steam by heat from the furnace of the boiler, is next passed through a series of tubes known as a superheater. These tubes are exposed in a heated portion of the furnace and thus the steam is raised to a point much higher than its saturated temperature.

The Separator. From the superheater the steam passes through suitable piping to a separator, placed between the boiler and the engine, or between the boiler and the turbine. This separator is placed as near the power unit as possible in order to remove all condensed steam that may be found in the pipes. One form of separator performs its function by quickly reversing the direction of the flow of steam, thus depositing the water into a drip which is drained off into the condenser. Another form gives a rotary motion to the entering steam thus hurling particles of water off by centrifugal force and collecting it in proper receptacles. Again, baffle plates are at times employed wherein the flow is interrupted by corrugated or fluted plates, and the particles of water adhering to these are then drained off.

Reciprocating Engine or Steam Turbines. The steam next goes from the separator to the main power generating units. The main units in earlier practice were reciprocating engines; in modern installations they are steam turbines.

Reciprocating engines may be divided into several classes, the details of which will not be outlined in this general discussion. Suffice it to say, however, that the main principle upon which reciprocating engines act is that steam enters a cylinder under pressure, thus forcing ahead a piston which is connected to a crank arm, thereby causing rotation and the consequent generation of power.

Steam turbines are divided into two general classes known as impulse turbines and pressure turbines. In the impulse turbine steam is allowed to expand in passing through a nozzle, thus causing the steam to travel at an enormous velocity. The steam, having acquired this velocity by impinging against movable blades, causes rotation and the consequent generation of power. In the pressure turbine, however, the steam is allowed to enter the buckets or rotating vanes at a comparatively low velocity. These vanes are so designed that the steam may expand in this movable portion and by means of its expanding



A = Supply water source.
B = Supply pump.
C = Hot well.
D = Feed-water pump.
E = Feed-water heater.
F = Economizer.
G = Boiler.
H = Superheater.
I = Separator.
J = Turbine.
L = Condenser.
M = Wet vacuum pump.
N = Circulating water pump.
O = Large water source
P = Dry vacuum pump.
Q = Railroad oil tank.
R = Storage tank.
S = Oil feed pump.
T = Oil heater.
U = Oil burner or atomizer.
K = Furnace.
W = Smoke-stack.

A Diagramatic Sketch showing the Steam, Circulating Water and Fuel Oil Cycles in the Modern Power Plant.

pressure cause rotation and hence the generation of power.

Turbines as a general rule have two other classifications, known as vertical and horizontal. The vertical turbine revolves upon a vertical shaft, which is supported at the bottom by a thin film of oil under the high pressure of about 900 to 1000 lb. per in. The horizontal turbine, however, as the name indicates, rotates on a horizontal axis, and is supported in the usual manner by means of suitable bearings.

Condenser. From the steam turbine, the steam, having expanded to its useful limit, is dropped into an incasement through which cool water is being passed. Upon coming in contact with this cooling device the steam is again converted into water. The apparatus performing this function is known as a condenser, there being two general classes: surface condensers and jet condensers.

In the surface condenser the steam from the turbine and the cooling water from a nearby source of supply do not come into direct contact, but the cooling water is passed through inclosed tubes around which the steam from the turbine or power unit is made to pass. This type of condenser is used where large quantities of water are available for cooling purposes but not for steaming purposes. Thus the use of salt water, the only abundant supply available for ocean-going steamships and large power plants situated near the ocean, makes a condenser of the surface type imperative for such installation.

In the jet condenser the supply of cooling water is allowed to mingle with the steam as it drops from the turbine or power unit and thus the steam is at once condensed into water. The water from the jet, being pure in supply, may be used in the hot-well for steam purposes.

Wet Vacuum Pumps. The condensed steam, now in the form of water, is pumped from the condenser back again into the hot-well by means of what is known as the wet vacuum pump. This pump may be either a reciprocating or rotary pump, but in general the rotary type seems to have the preference. Thus the entire cycle for the water is traced from the make-up tank or hot-well through the boiler and power unit, and back again to the hot-well.

Dry Vacuum Pumps. The condenser also has a dry vacuum pump in order to remove from the steam space within any air which may have been trapped from the steam generated in the boiler. This pump is nothing more nor less than an ordinary air compressor so designed that it will take air at a very low pressure and compress it up to atmospheric pressure, thus pumping, as it were, into the outer atmosphere such air as may have been entrapped in the condenser.

Circulating Water Cycle.

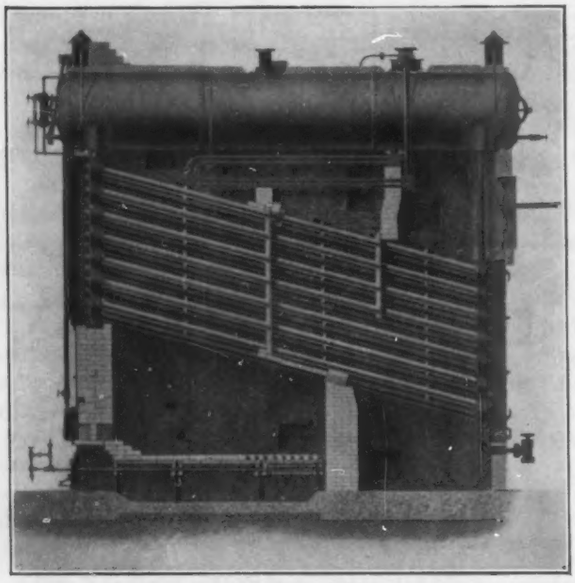
From the description of the working of the condenser it is seen that cooling water is necessary to convert the steam in the condenser back again into water. This cooling supply is known as circulating water, which is usually taken through pipes from some large natural lake or river or even the ocean and forced by means of reciprocating or rotary pumps through the condenser back again into the open. The water in its journey is raised in temperature in the surface condenser system from 25 to 30 deg. F. above its entering condition.

The Oil Cycle.

Of general interest to boiler testing and operation is the oil cycle employed in the utilization of crude petroleum as a fuel. Let us then briefly trace the journey the oil makes through the modern power plant.

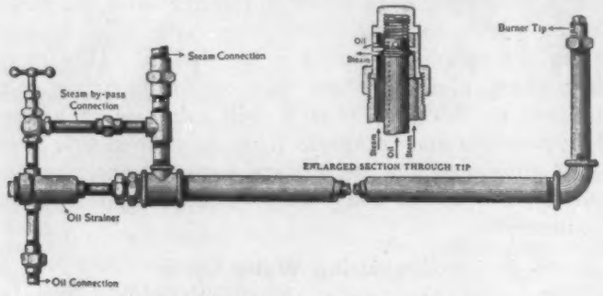
In the larger installations the oil is sidetracked from the main railway line in specially designed cars for its easy conveyance and handling. An oil heater,

consisting of a coil through which steam is passing, is lowered into the car in order to warm the oil as it is drawn, thus making its transfer considerably easier. By means of a pump this oil is then taken into a stor-



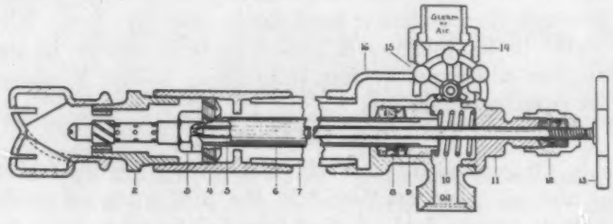
Cross-section of the Babcock & Wilcox Boiler—Oil-fired.

age tank which may be of wood, steel, or concrete, depending upon the permanence of design thought necessary. From this storage tank the oil is pumped through oil heaters, the exhaust from the pumps in many cases being utilized in still further heating the oil before it reaches the burner or atomizer.



The Peabody Fuel Oil Atomizer.

An atomizer is a device used to vaporize or spray the oil into the furnace in fine globules or particles. This is accomplished by means of steam, air, or some mechanical contrivance. Immediately upon its being



The Staples & Pfeifer Fuel Oil Atomizer.

sprayed into the furnace carefully designed air regulating devices admit sufficient air from below to cause perfect combustion. The heat thus liberated from the oil due to its burning with the oxygen is caused to flow in and around numerous tubes through which water is passing and thus this water is converted into steam. After passing these tubes the heated flue gases brought to life by the burning of the oil with the entering air are then conducted through the chimney out into the atmosphere.

As an instance of excellent design in fuel oil practice, let us briefly review the fuel oil equipment of the Redondo plant of the Pacific Light & Power Company.

The oil is pumped under pressures which vary from 10 to 50 lbs., depending on load conditions. There is a uniform oil pressure throughout all portions of the plant. All burners run wide open, or nearly so.

The amount of oil burned, with variations of load, is controlled by the pressure of oil at the oil pumps, the intensity of fire increasing or decreasing in all boilers simultaneously.

The oil pressure is automatically controlled by a steam pressure regulator. The variations in the oil pressure and the intensity of the fire are such as to maintain a uniform steam pressure on the plant.

The steam for atomizing purposes is supplied by a separate low pressure main. The pressure in this main is automatically controlled by the variation of the oil pressure in the oil main. A ratio regulator is used, automatic in its action, which maintains such a steam pressure in the low pressure main as is necessary to atomize the amount of oil burned. In this plant the proper amount of steam for atomization is furnished under a steam pressure equal to three times the oil pressure, plus 30. This relation, of course, varies and depends upon the burner used.

The air supply for combustion is controlled by a damper controller, automatic in its action, which increases the damper opening with an increase in oil pressure and vice versa. The movement of the controlling lever is due to the oil pressure on a diaphram. This movement is opposed by a spring such that the amount of movement on the main lever is proportional to the oil pressure. Power for its operation is secured by means of a hydraulic cylinder which connects to a rock shaft and controls all the boilers from one panel. The connecting levers are set at such angularity as to give the proper air supply at various loads.

General Summary.

Thus it is seen in this brief description that by using crude oil as fuel three main cycles of operation are synchronously carried on in the modern power plant. Briefly summarizing, these are as follows:

Water is taken through the boiler, converted into steam and passed through a driving mechanism, after which the steam is reconverted into water and this water again passed through the boiler. Simultaneously with this action water is being pumped through the circulating system to bring about the conversion of the steam from the power unit into water. Again oil in a finely atomized or gaseous state is being fed through pipes into the furnace, where it immediately combines with the proper quantity of oxygen from the entering air, and thus sufficient heat is liberated from the oil to evaporate the water supply of the boiler into steam for power generation.

SPARKS—Current Facts, Figures and Fancy

More and more it is being established that the electric drive for battleships has undoubted superiorities over any other known method of propulsion.

* * *

Law and order have finally been restored in the Atlanta, Georgia, reign of terror over the street railway traffic situation in which thirty-one cars were dynamited.

* * *

Even the turtle is feeling the impetus due to growth in foreign activity of the United States. Costa Rico has granted a concession to certain American citizens for the fishing of huge three hundred pound turties along her beaches and waters for the next five years.

* * *

In Eastern states it is being urged to get more and more the full value of coal by recovering its useful by-products when combustion has taken place. The recovery of by-products from fuel oil consumption on the Pacific Coast might with much profit be investigated.

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The Bureau of Standards at Washington is becoming more and more to be recognized as an institution that occupies toward manufacturing an indispensable relationship. The wide range of research activity undertaken is proving of immense value to industries the country over.

* * *

"The Christmas Electrical" was evident in all cities of the West. Especially was this true among the smaller communities such as Lodi, California, where the electrically illuminated Christmas tree erected in the public throughfare near the railroad depot, greeted the passenger traffic of an empire during Christmas week.

* * *

The new Rochester electric street cars which have been named the "Car Rider's Car," are said by the Electric Railway Journal to represent the last word for street car evolution in the matter of wide entrances, anti-flashing controllers, anti-friction bearings, liberal window area and conspicuous route signs with front and center exits for passengers.

* * *

The governmental railroad now being built in Alaska from Seward to Fairbanks will do more than any other single factor in unlocking the vast natural resources of this section of North America. The road is to be 466 miles in length, of which a distance of 136 miles has been built and is now in daily operation. The total cost is to be over twenty-five millions. Eleven millions of dollars have already been spent upon the work. Four thousand men are now employed.

* * *

Port Kembla, when it is finished, will be one of the finest harbors of New South Wales. The work of construction in connection with the breakwater and wharfage accommodations has been proceeding for fifteen years, but is now nearing completion. The port is situated fifty miles south of Sydney and is destined to be the shipping port for the bulk of the coal from the southern fields.

* * *

Foreign countries are showing deep-seated appreciation for their great captains of industry and engineering during the present international war. Sir Albert Stanley, the founder of the present excellent transportation system in London, has been appointed to the British Cabinet. In America, too, the public are more and more clamoring for the trained analytical mind of the engineer in the conduct of public affairs.

* * *

It is not stated in the reports that the electric lamp is the cause of the disappearance of the sperm whale from northern latitudes, yet who knows but what his jealous animal instinct has led him to frequent more and more the latitudes to the south. At any rate most of the whale fishing of Norway is now done in the Southern Hemisphere. The total catch last year yielded four hundred sixty-five thousand barrels of whale oil valued at about seven million dollars.

* * *

It is highly probable that rice production which has been found so profitable to the grower and to the hydroelectric power companies in California, will also extend to other countries to the south. In two coast departments of Peru the cultivation of rice claims the attention of the greater part of the inhabitants. The yield is about fifteen hundred pounds per acre. The total production last year amounted to forty thousand metric tons.

* * *

As in the economic development of the public utility, monopoly under public regulation proves to be the ideal method of evolution, so in the growth of western cities unified interest with neighborhood reservations is the trend of municipal growth. The new San Francisco, combined with Oakland, Berkeley, Alameda and other neighboring cities nearby setting forth nearly a million inhabitants is a proper goal for centralization of municipal effort in California.

* * *

With an advertisement headed "Joslin's the Daylight Store," this firm has made known to the Denver public that it is using this form of illumination. The body of the advertisement relates that the daylight lamps are being used throughout the store and in the show windows, further stating the advantages of this illumination in the matching of colors and discerning workmanship, etc. A description of the lamp follows —telling of the rays sent out, that they are blue instead of yellow, and that they imitate natural daylight as no other form of illumination can do.

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THIRTY YEARS OF SERVICE.

With this issue of the Journal is inaugurated the thirtieth year of its eventful life. During this period it has been its privilege to chronicle and comment upon all the now famous engineering events that have made engineering activity in the West known the world over. Its editorial columns have been read and quoted in practically every country of the civilized world and its message of scientific and engineering discernment has been favorably received by a host of loyal friends wherever its pages have been read.

The new Journal—the Journal that now addresses as an audience the countries bordering the great Pacific—goes forth with the strength and courage acquired from years of careful training and nourishment to assist in building up the greatest commercial and engineering arena that has ever before been exploited in the history of human activity. The Journal greets the countries bordering the Pacific with its spice-laden islands, and offers to them its banner of thirty years' standing, "at your service."

A Journal founded upon broad principles of justice and education, like the state university, never dies. Hence, in the prime of its manhood, in full knowledge of its splendid achievements of the past, the Journal of Electricity pushes on, pausing for this moment only to note the passage of a friendly mile post—"Thirty years of Service."

Commercial and Engineering Interchange

A new era of commercial and engineering activity is being ushered in upon the Pacific area that in its incipiency must be launched upon the broadest principles possible to international interchange.

In the past many things have arisen sometimes with, but more often without foundation in fact, to mar friendly intercourse with certain of the countries bordering the Pacific.

It is now almost universally recognized that in order to attain the utmost in human interchange all parties to the issue must partake of the benefits to arise from a contract of interchange else sooner or later it will be found that the contract is in force by name only. Domination of interest—that interest which says, "I, the great I, am to be the favored one," has done more to create inharmony and disrupt nations than any other factor. For a forceful example of this witness the present international war in Europe.

In view of this fact it would seem an excellent and opportune time to lay broad lines of commercial and engineering regulation for the countries bordering the Pacific so that from the start evil practices that were possible in America before the advent of the modern regulating commissions may be avoided.

By so doing the strong bonds of community of interest among those countries as a unified whole, will be immeasurably strengthened and the ties of com-

munity of race and religion so flagrantly lacking be made to appear of little importance.

In a word what is needed is a body of highly representative engineers and business men called from the individual countries bordering the Pacific, either legally designated or voluntarily called from the engineering and commercial organizations of the countries to properly pave the way for the international activities ahead.

These activities will not come suddenly. Their growth will be slow, but under careful nourishment they will be substantial in nature. A basis of common understanding is the first necessity. This common understanding may be easily established in this day of first things in the great Pacific arena of commercial and engineering activity and in this day of first things the engineer should play the leading role.

The Growing Importance of Fuel Oil

The recent "scarcity of oil scare" has arisen not so much from any anticipation of shortage in oil production as from its now universally recognized advantages in the generation of power. This is especially seen in the trend of marine design. The enormous increase in shipbuilding on the Pacific Coast has served vastly to strengthen this utilization of fuel oil operation.

But the factor that is contributing more than any other to creating the scare of fuel oil diminution is the extreme importance of fuel oil operation in the propulsion characteristics of the modern navy. The cleanliness of supply, the ease of manipulation, the reduction of storage space, and the increased efficiency under fuel oil operation are factors that lead naval experts to place fuel oil so far above other means of power generation as to make other methods of power generation appear insignificant in comparison.

This growing importance of fuel oil applications in the generation of steam has brought about a renewed interest among engineers and operators in the study of fuel oil and steam engineering.

To meet this pressing demand for first hand educational knowledge along these lines there is inaugurated with this issue a series of articles on "Fuel Oil and Steam Engineering" which will deal with practically every phase of the subject matter suggested in the title. The articles will each be independent of the other as they appear from time to time, yet taken as a whole they will constitute a valued contribution to this important phase of modern generation of power.

Central Station Merchandising

One of the livest questions before the electrical men of the West today is the tendency of central stations to sell electrical appliances in general and ranges in particular. It is much like the old question of selling lamps, but is minus the argument that this is a necessary part of the power company's service to the consumer. Good reasons for and against the practice are presented by both sides.

The central stations have found that the expenses of a range selling campaign have been too great for the average electrical dealer to undertake. Where this class of business is left to the dealers' initiative the sales lag. Consequently the central station is deprived of this desirable load.

Consequently, many power companies have taken the matter in their own hands and are successfully conducting electric range campaigns. They carry on extensive advertising and demonstrations, they employ expert salesmen and they personally see that all ranges are giving satisfaction after being put into service. As far as the receipts from the sales are concerned, this business is conducted at a loss of about $25 for each range installed at the list price. This deficit is made up later by the sale of current.

The central stations argue rightly that no dealer can afford to assume the burden of this promotion work. The electric range is still in the exploitation stage. The public has to be educated regarding the advantages of electric cooking. And so in order to quickly get the off-peak cooking load the power company is compelled to carry on this creative sales work. Furthermore they feel that as they are bearing the cost of the work ordinarily done by both the jobber and the retailer they are entitled to at least as low a price as is given the jobber.

The jobber and dealer, on the contrary argue that the central station is disorganizing the entire electrical industry by selling appliances, especially when they cut below established prices. Their creed recognizes four well established branches in electrical trade—the manufacturer, who furnishes the material, the jobber who stocks and distributes it, the retailer who sells it, and the central station who furnishes the current which operates it. They believe in the policy of live and let live, that each branch should confine itself strictly to its legitimate functions, and that any encroachment upon the prerogative of the other should be inhibited. They contend that the central station has no more right to sell appliances than has the dealer or jobber to sell current.

A logical way out of this conflict of ideas would seem to be for the central stations to devote the time and money they are now expending to educate the public to the education of the dealer. Instead of working against the dealer it is suggested that they work through them, even to the extent of losing their salesmen to the dealer. In this way they could get an even greater volume of business and incidentally win the good-will of the jobber and dealer.

Of far greater inportance to the central station that any immediate expedient in load-building is the necessity for developing friendly relations with the public. Each salesman of each jobber and each dealer is in the public mind a representative of the electrical industry. In the aggregate they form a great army capable of making or marring a favorable public sentiment toward the central station. By upholding the hands of the dealer the central station is thereby strengthening its own position with the public. It would therefore seem that any temporary advantage in accelerating the growth of off-peak business should not counterbalance the broader benefits to be derived from a harmonious electrical industry—"each for all and all for each."

PERSONALS

A. R. Parsons, of the A. R. Parsons Electric Company of Porterville, California, was a recent business visitor at San Francisco.

Charles E. Eyman, of the Standard Electric Company of Visalia, Cal., spent a few days in the latter part of the week at San Francisco.

T. E. Bibbins, president of the Pacific States Electric Company, has returned from an extended business trip throughout the East.

Martin Behrendsen, purchasing agent for the Valley Electric Supply Company, of Fresno, was a recent business visitor at San Francisco.

W. C. Johnson, representative of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from a vacation at Red Bluff, California.

R. L. Taylor, electrical contractor in Seattle, Wash., is a recent arrival at Los Angeles and expects to spend a few days in San Francisco on his return to Seattle.

J. P. Bell, Pacific Coast manager of the Standard Underground Cable Company, recently returned to San Francisco from an extended business trip throughout the East.

F. D. Fagan, manager of the Edison Lamp Division of the General Electric Company on the Pacific Coast, has returned to San Francisco from a ten days' trip to Los Angeles.

H. W. Doubrava, for many years with the New York office of the Wagner Electric & Manufacturing Company, is now connected with the Los Angeles office of the company in the sales department.

F. H. Leggett, formerly Pacific Coast manager of the Western Electric Company at San Francisco, expects to leave for the East by January 5th, where he will resume his duties with that company in New York.

E. C. Bennett, Mercury of the Jovian Order, has been added to the board of directors of the Society for Electrical Development as the Jovian representative, **Henry L. Doherty,** Jupiter, already being president of the Society for Electrical Development.

Max Loewenthal, lately with the Dohrmann Commercial Company, has returned to San Francisco from an extended trip throughout the East, and has opened offices for the United Trading Company, handling a number of electrical sales agencies.

Oscar C. Roos, radio engineer, is at San Francisco from the Philippines, where he has had charge of the wireless station for a number of years. Mr. Roos is a pioneer in the wireless work, having been connected with the Schumaker & De Forrest Company in 1903, and for years was chief engineer for the Radio Telegraph & Telephone Company on the Great Lakes. He was the inventor of the first commercial arc while connected with the National Electric Signaling Company as research engineer.

Winfred B. Holton, Jr., formerly assistant director in supervision of New York State Work, has been appointed director of the San Francisco Bureau of Municipal Research from January 1, 1917, and will shortly assume his new duties in San Francisco. Mr. Holton is a graduate of Wesleyan University, has made intensive studies of public works administration in Philadelphia and in the Borough of Manhattan, New York City, and subsequently he continued public works specialization and made surveys in Springfield, Mass.; Waterbury, Conn.; Toronto, Canada; Portland, Ore.; Denver, Colo.; Milwaukee, Wis.; Rochester, N. Y.; Buffalo, N. Y.; Alleghany County, Pa.; Monroe County, N. Y., and Brandon, Canada.

MEETING NOTICES.

Los Angeles Jovian League.

With Jacob H. Leeds of the General Electric Company as chairman of the day on December 20th a large crowd gathered to personally extend the compliments of the season and enjoy the double-header bill. Harry C. Carr, assistant managing editor of the Los Angeles "Times," gave an interesting address on "America's Position Commercially at the Termination of the War." H. H. Cudmore, director of the Mazda Bureau of the General Electric Cimpany, in characteristically happy style took a "Ramble at Random." The entertainment feature was well cared for by Miss Mercedes Crecelska, a young Polish artist with an unusual voice who sang some favorite selections in costume.

San Francisco Electrical Development and Jovian League.

The Christmas spirit pervaded the December 20th lunch. R. F. Behan, as Santa Claus, presented every one of the 80 members present with a gift from the electrically lighted tree. Past President Cutting was presented with a handsome piece of pottery as a loving cup. After the distribution of gifts President L. H. Newbert introduced T. E. Collins as chairman of the day, who in turn introduced Miss Bessie Beatty of the San Francisco Bulletin. Miss Beatty explained her work in providing Christmas stockings for 2500 poor children at Christmas time and also in maintaining a summer vacation camp. She was given a rising vote of thanks and also carried away a stocking well filled with coin to aid the good cause.

Joint Meeting of Portland Sections N. E. L. A. and A. I. E. E. With the Oregon Society of Engineers.

The bi-weekly luncheon of the Joint sections of the N. E. L. A., A. I. E. E. and the Oregon Society of Engineers was held at noon December 20th, in the orange room of the Oregon Hotel, Portland, Oregon. E. G. Hopson, consulting engineer and vice-president of the Oregon Society of Engineers, was chairman of the day. Fifty were in attendance. Judge C. U. Gantenbein gave a short talk on "The New National Defense Act," with special reference to the Engineers' Reserve Corps. There will not be another meeting of the luncheon club until January 17th, at which time the General Electric Company will have charge of the meeting with E. F. Whitney, chairman.

Oregon Society of Engineers.

The regular monthly meeting of the Oregon Society of Engineers was held in the ladies' dining room of the Oregon building, December 22d.

W. S. Turner, president of the Oregon Society of Engineers, presided as chairman, and the whole evening was devoted to talks on electricity. O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, spoke of "Recent Achievements in the Electrical Field." R. R. Robley, operating engineer for the Portland Railway, Light & Power Company, discussed "Historical Phases of Electricity," with special reference to local conditions. W. H. Lines, commercial engineer for the Portland Railway, Light & Power Company, told of the "Commercial Application of Electricity."

An amendment to the constitution was proposed and will be voted upon later. The vote will be upon the proposed change of the president's term of office to one year instead of two years, and the vice-president's term of office to one year instead of two years, and make them not eligible for re-election for two successive years.

The architects of Oregon will have an architects' license law introduced before the Oregon legislature this year, and they asked the Oregon Society of Engineers for their support. It was referred to the legislative committee. This bill provides for an examining board of five members, and

requires all architects to register and be passed upon by the board. Those eligible must have engaged in business a specified period of time or worked for another concern which has been in the business. The law is modeled after the New York law.

The Oregon Society of Engineers has appointed a delegate to represent them in the Oregon Good Roads Conference, which is considering Good Roads Legislation. The society will also be represented at the Irrigation Congress, which meets in Portland the first of January, 1917. The attendance was twenty-seven.

THE OREGON IRRIGATION CONGRESS.

The Oregon Irrigation Congress will convene at the Imperial Hotel in Portland, January 4, 5 and 6, 1917. The main subjects to be discussed will be irrigation practice, federal aid, state legislation for irrigation districts, needs of Oregon irrigation projects, financing of irrigation projects, cooperation with federal departments to assist Oregon irrigation development and the use and misuse of water.

NOTES OF THE PUBLIC UTILITIES COMMISSION OF IDAHO.

In reference to the application of J. E. Marsh and H. B. Logan, a co-partnership, doing business under the firm name and style of Marsh & Logan, for certificate that present and future public convenience and necessity require the construction of an electric power plant to supply the village of Rockland and four surrounding townships, all in Power County, Idaho, with electricity, the commission granted the request.

In the matter of the application of the Idaho Power Company for a certificate of convenience and necessity for an extension to and within the village of Eden, Minidoka county, Idaho, the application was granted.

Village of Roberts, Complainant, vs. Ashton and St. Anthony Power Company, Limited, defendant. Utah Power & Light Company, Owsley-Carey Land & Irrigation Company, Mud Lake Canal Company, North Lake Canal Company, Crystal Lake Irrigated Lands Company and various farmers owning lands under the Butte and Market Lake Canal, Intervenors. The commission ordered the case dismissed.

SEATTLE'S PARTICIPATION IN AMERICA'S ELECTRICAL WEEK.

BY R. W. CLARK.

Seattle participated in America's Electrical Week by organizing an Electrical Show which was open afternoons and evenings December 4 to 9 inclusive. The entire second floor of the O'Shea Building at Fifth avenue and Pine street, with an area of about 9000 square feet was secured for the purpose. A large number of 1000 watt units, colored festoons and an electric sign made the outside of the building the brightest spot in the city.

Publicity material furnished by the Society for Electrical Development was used on billboards, in street cars, through the mails and through local electrical houses. This week and the success of the show held last year secured an attendance that was all that could be desired.

A large majority of Seattle's electrical interests took space, installed good exhibits, and conducted continuous demonstrations, so that there were no "dead spots" among the displays. All the energies of the show committees were devoted to making the event mainly an electrical educator for the public, and no entertainment features, except good music, were furnished. It is the belief of all concerned that the public took the show in the spirit in which it was offered, and it was noted by all exhibitors that the questions asked by the public were not prompted by curiosity but by a real desire to know about the latest developments in electrical appliances. As was the case last year, electric ranges and other cooking appliances held first place in public interest.

The direct results of such an exhibition are always hard to determine, but we note that our appliance sales during the week were just double those of the previous week, and we are working on prospects which should result in the sale of a large number of electric ranges and many small appliances within a short time. The other exhibitors report similar results, and are apparently well satisfied with their participation in the show. Furthermore, the spirit of co-operation shown by competing jobbers, dealers and contractors is very gratifying.

We think that such an electrical show, with free admission is the best method of reaching the public in America's Electrical Week, and expect that it will be made an annual event here.

The following list gives the names of the exhibitors, and the nature of their display:

The Perfectalite Co., lighting fixtures.
Electric Sales Corporation, water heaters and bakery ovens.
Automatic Controller Co., electrical heat controllers.
Puget Sound Traction, Light & Power Co., ranges, appliances, water heaters.
Instantaneous Alarm Co., public and private alarm systems.
Coin Machine Mfg. Co., induction water heaters.
Globe Electric Co., ranges and appliances.
Northwestern Supply Co., ranges, appliances, lamps, batteries.
Metropolitan Electric Co., switchboards and cabinets.
North Coast Electric Co., ranges, appliances, lamps, compressors.
Fobes Supply Co., ranges, appliances.
DeLay Sales Co., vacuum cleaners and washing machines.
Electrical Contractors' Association.
Pacific States Electric Co., appliances, charging sets, lamps, laundry machinery.
Lushington Electric Co., lighting fixtures and appliances.
A. H. Cox Co., small motors, repairing and electrically operated tools.
Delco-Light, lighting systems.
A. G. Behreman, Inc., lighting fixtures.
Kilbourne & Clark, radio systems.
Sunset Electric Co., electrical appliances for automobiles.
Western Electric Co., ranges, appliances, lamps, telephone sets.

TRADE NOTES.

The Holabird-Reynolds Electric Company, announces a change of name to the Graham-Reynolds Electric Company, jobbers of electrical supplies, 300-302 East Third street, Los Angeles. Broadway 200, Home 10555.

The Wagner Electric & Manufacturing Company of St. Louis announces that its San Francisco office will remove to 159 New Montgomery street to combine with the service station of the company.

UNITED STATES CIVIL SERVICE EXAMINATION.

The United States Civil Service Commission announces an open competitive examination for assistant examiner in the Patent Office, for both men and women, on January 17, 18 and 19, 1917. From the register of eligibles resulting from this examination certification will be made to fill vacancies as they occur in this position at the entrance salary of $1500 a year, in the United States Patent Office, Washington, D. C., unless it is found to be in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

NEW BULLETINS.

The General Electric Company has just issued bulletin No. 44417 on The G.E-258 Ventilated Commutating Pole Railway Motor.

The Chicago Pneumatic Tool Company has just issued Bulletin 34-W on "Giant Fuel Oil Engines," and Bulletin No. 263 on Boyer Railway Speed Recorder.

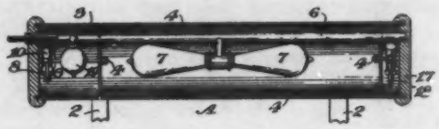
The Underwriters' Laboratories has recently issued a booklet of twenty-four pages on Electrical Data. This booklet contains valuable research information relative to methods of fire prevention from electrical sources together with a discussion of causes that have produced fires in the past from electrical defects in the wiring installation.

WHAT WESTERN INVENTORS ARE DOING

(On this page may be found a brief description of typical patents just issued to inventors in the West.—The Editor.)

1,208,302. **Vehicle Signaling Device.** Robert F. Duryea, San Francisco, Cal.

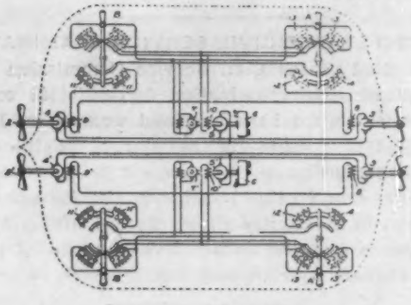
A vehicle signaling device, a cylindrical casing having closed ends and sight openings in its periphery, an inner cylinder having its ends closed and spaced from the ends of the casing to form end compartments, longitudinally arranged shafts fixed to the casing ends and rotatably supporting the inner cylinder, cylinder-rotating means arranged in one end compartment, between one end of the casing and the



adjacent end of the cylinder, the ends of the cylinder being formed with arcuate slots arranged in proximity to the periphery of the cylinder, a source of light arranged in the other end compartment between the opposite ends of the casing and cylinder and visible through one of the sight openings, the adjacent closed end of the cylinder preventing the passage of light rays from said source of light into said cylinder, a source of light disposed in the cylinder and visible through another sight opening, and a tubular member fixed to each of the ends of the casing and passing through the arcuate slots of the ends of the inner cylinder to serve as a steadying means for the latter, said tubular member also having both sources of light connected thereto and constituting the sole support for the sources of light aforesaid.

1,208,429. **System of Electric Propulsion.** Merle J. Wightman, Seattle, Wash., assignor to General Electric Company, a Corporation of New York.

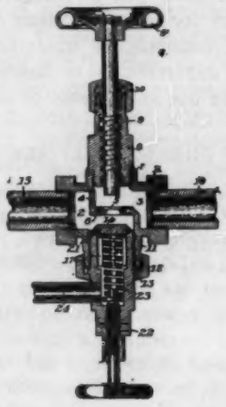
A system of electric propulsion of a vessel, propellers for said vessel located at the opposite ends thereof, an inde-



pendent motor for driving each propeller, and a controlling device near each end of the vessel for simultaneously controlling the motors at both ends and for maintaining a lower speed of the motor driving the propeller at one end of said boat than that of the motor driving the propeller at the other end.

1,208,292. **Valve.** Garnet W. Coen, San Francisco, Cal.

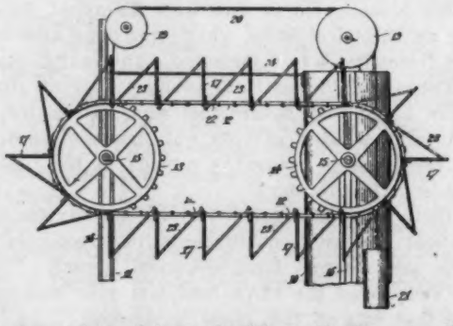
The valve casing having an inlet opening connected with a source of fluid supply under pressure and an outlet opening connected with a service line, of a pair of passages in the valve casing having valve seats formed therein, one of said passages forming communication between the source of supply and the service line, and the other passage forming communication between the source of supply and a return, a valve interposed between the valve seats adapted to be normally actuated by the fluid under pressure to close the passage between the source of supply and the return, mechanical means within the casing for automatically projecting the



valve against the opposite seat to shut off the flow of liquid through the service line the moment the fluid pressure drops below a predetermined pressure, and means for positively retaining the valve on its seat to prevent the automatic operation described.

1,208,611. **Water-Current Motor.** Warren C. Miller, Medford, Oregon.

A fluid current motor comprising a pair of hollow caissons arranged in parallel spaced relation and having the confronting faces thereof provided with vertically extending guideways, a pair of vertical beams arranged in spaced relation to the caissons and in alinement with the guideways, said beams being spaced from each other and having the con-



fronting faces thereof formed with vertically extending channels, shafts slidably mounted in the guideways and in the channels, sprocket wheels keyed to each of the shafts, said sprocket chains trained over the sprocket wheels, blades mounted on the chains, pulleys journaled at the upper ends of the beams and caissons, and weighted cables connected to the shafts and trained over the pulleys, said cables being secured to the opposite extremities of the shafts and lying in said channels and guideways.

LATEST IN EVERYTHING ELECTRICAL

(It is the purpose of this department to chronicle the very latest advance in industrial activity of interest to engineers. In this issue recent advances in office space design, electric railway signals, and ice making by electrical means are considered.—The Editor.)

RECENT ADVANCES IN ARRANGEMENT OF OFFICE SPACE.

BY WALDO C. COLE.

Office of the Manager.

THE definite disposition of each detail so that there is no necessity to give it further thought, saves time and permits those who find greater demands made upon them from day to day to easily assume responsibility without becoming overburdened.

In planning the new quarters of the Westinghouse Electric & Manufacturing Company, on the seventh floor of the First National Bank Building, San Francisco, it was recognized that a modern office would have to meet the conditions outlined above, besides adapting itself to those principles which have been recognized for a considerable period of time as standards.

In order that the clients of the Westinghouse Electric & Manufacturing Company calling at the office might be provided with equipment where they can give close attention to the problem under consideration, and not be confused with details of other work handled by the other salesmen, two conference rooms, one on each side of the district manager's office, opening into the reception room, are provided. As soon as the operator in charge of the information desk learns the desire of the caller, the interested representative is notified, who collects all the necessary papers and data that will be of interest to and required by the caller, then proceeds to the reception room and shows the caller into one of the conference rooms, where a telephone and large table and chairs sufficient to seat all interested are provided.

The sales force has been organized so that even if the man handling the caller's business is away from the office, a member of the office sales division can give his immediate requirements attention and transmit all of the necessary information to the salesman interested, who can later give further and more detailed study to the proposition.

The office sales division has quarters just off the reception room, where the necessary privacy is assured to those wishing to talk upon any details with the men of this division.

At one end of the large room, serving as the office of the salesmen, are two small offices; at the other end there is only one office. These small offices are used by the respective division managers. The men of each division are grouped adjacent to the office of their manager. This arrangement lends itself to the quick dispatch of essentials that must come to the attention of one of the division heads for advice or suggestion.

The offices of the treasury department are so situated that they can be easily reached by the members of the sales department and clerical division in order that the vital questions pertaining to this department can be quickly considered and disposed of; at the same time the arrangement assures the customer, who finds it necessary to discuss financial matters, the desired privacy and freedom from interruption, which is necessary for satisfactory consideration of questions of this kind.

The clerical department is housed in one large room, where each of the clerks can easily come in personal contact with any of the others if he should find it necessary to have additional information relative to the particular matter receiving his attention. This arrangement discourages a practice that naturally grows up where a clerical department is housed in more than one room, of saving up a number of documents to be discussed whenever it is found convenient to make a trip from one room to another; but rather encourages the quick, accurate and ready dispatch of the particular business at hand.

The promotion division has a room separate from the rest of the office, where provision has been made for the storage of publications and data, so that it is convenient for immediate access for mailing to customers who are interested in any particular development of the electrical art related to the Westinghouse Electric & Manufacturing Company.

An Interior Office View.

Although the products of the Westinghouse Lamp Company are not as diversified as the Westinghouse Electric & Manufacturing Company, and their local organization not at complex as that of the latter company, a close study was given to make their offices as efficient for handling their business as that of the former. Due to the smaller organization, it was found that the conference room plan could be dispensed with, and that the private offices of the manager and salesmen of the lamp company would insure their customers the privacy which is so essential in giving close consideration to the commercial details of an illuminating problem. There are two private offices provided, one for the manager and one for the salesmen.

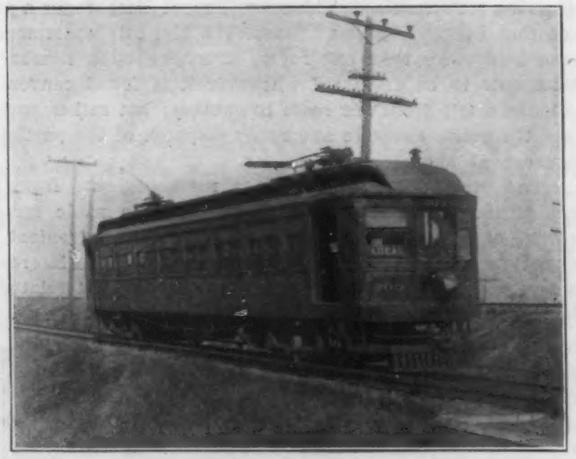
The offices of both of these companies are laid out with an idea of giving their customers the best service that could possibly be obtained.

RECENT DEVELOPMENT IN RAILWAY SIGNALING.

Railway signaling has developed into an important branch of electrical industrial work. Automatic block signals, based on track circuit, are now standardized to a great extent and used by main steam and electric trunk lines. In subways and terminal yards, where traffic is heavy, block signals are essential to the safe and effective movement of trains, and the signal art has been developed to keep pace with modern high pressure conditions.

Special consideration is given the Simmen System in this article. The Simmen System is based on cab signals, as against fixed signals placed along the right-of-way. Cab signals not only have many legitimate reasons for their use, but in addition to effectiveness, they cheapen the first cost of installation and reduce maintenance costs.

Assuming that in the United States there is approximately four miles of track to every motive power unit, we have one signal equipment on one motive power unit to balance up against all the fixed signals that would be placed on four miles of track. Two fixed signals per mile is a fair average, which makes eight to one in favor of cab signals.



Angle Iron Ramp Rails and Car Contact for Railway Signal Installation.

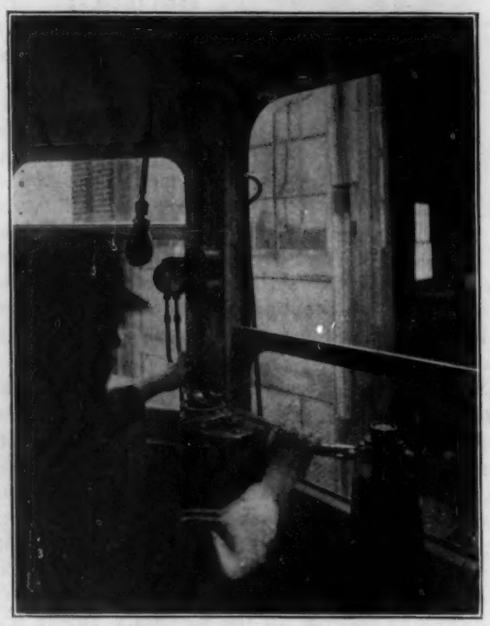
A charge against the cab signals, however, must be made in the cost of ramp rails, which are located at every signal point. Ramp rails are not an expensive consideration, since they consist of an angle iron mounted on insulated brackets, as shown in the illustration. The electrical contact to the car is made by means of a contact shoe mounted on the car truck, as shown. The signal indication is given by means of red and green lights in a signal box located in front of the engineer, as shown in the second illustration. The car apparatus consists of a battery for operating the cab signals, a polarized relay, a directional switch, the lamp box and the contact shoe above mentioned. The track apparatus is, of course, similar to that used in standard track circuit practice, except that ramp rails are installed at signal points.

The operation of the signal system may be expressed by a train movement as follows:

When the locomotive goes into service the directional switch is thrown in the direction in which the train is to move. In any case this will mean a red light in the cab. On leaving the terminal, if the block is clear, the locomotive will pick up a green light on the first energized ramp rail that it passes over. This green light replaces the red and will be carried through to destination if the line is clear. The green light is picked up by outside current flowing through the car relay when the shoe is in contact with the ramp rail. This outside current lifts the armature of the relay and makes it possible for the car battery current to flow through the green light circuit. On leaving the ramp rail the armature is sustained in its top position by means of the same current that lights the green lamp.

Any failure of the current on the car or any injury to the contact shoe will break the holding current and the armature will drop by gravity into a position which shunts the car circuit through the red light. If the car circuit has failed, and there is no red light, there exists a similar condition to "lights out" with fixed signals, which is always assumed to be equivalent to danger.

The practical application of ramp rails involves what is known as a "distant" rail and a "home" rail. However, strictly speaking, these two rails are simply one long, continuous rail, extending for the full train braking distance at maximum speed. In view of the fact that this distance may be 2500 ft. or more, the center section of the rail is removed so that there simply remains the far end for about 40 ft. and the near end, say 70 ft., connected together by a wire. This saves expensive rail location and serves the same purpose



Electric Railway Signals Produced in Cab of Locomotive.

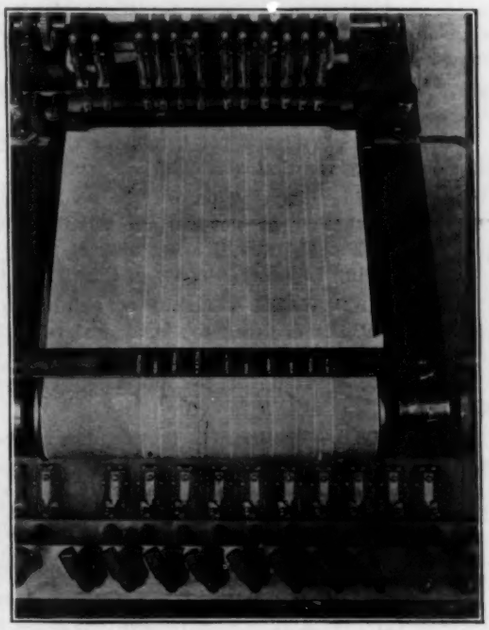
that a continuous rail would accomplish. The effect of a danger signal would be the same in either case.

The locomotive approaching the ramp rail that had been deenergized by means of a danger block condition (or defect of signal equipment) would have the green light changed to red as the contact shoe passed up on the ramp rail. Since the speed of the train may be very high at this point, the train would travel on to the far end of the rail (or what is known as the "home" rail) and come to a stop at that point. Stopping over the home rail is equivalent to stopping behind a red board, as with fixed roadway signals. The length of the home rail is made to accommodate the service on the road. An engineer running over a home rail would simply back up into position just as though he had run by a red the speed of the train may be very high at this point, the ing come to a stop, would then wait until the presence of energy in the ramp rail, picked up the car relay and restored the green light.

The principle of giving the first danger indication at an absolute predetermined point in advance of the signal location is quite different from fixed signal practice where the red board may be observed at varying distances, depending upon light and weather conditions; also background conditions and many other influences.

In the Simmen System the point where the engineer is first informed is always a fixed certainty.

A second important step made by the Simmen System is the method of enforcing obedience to signals, which is now crudely attempted by means of automatic stops of various types. In view of the fact that a circuit for signals has been once established on the locomotive, and that the signal indication changes at a fixed point in advance of the stop point, it is possible to introduce a speed control device that will operate on the air brake mechanism, if the speed of the train is not retarded as it should be. In other words, at any point between the "distant" and the "home" rails where the actual speed exceeds the speed as it should be retarded to insure a stop at the danger point, the speed control will reduce the speed automatically, and then restore the control of the train to the engineer until necessary to reduce it



Movement of Trains Recorded in the Dispatcher's Office.

again. An absolute violation on the part of the engineer would result in a series of applications of the air just about as he should do to bring the train to a stop, except that they will be somewhat later and more severe than usual service applications.

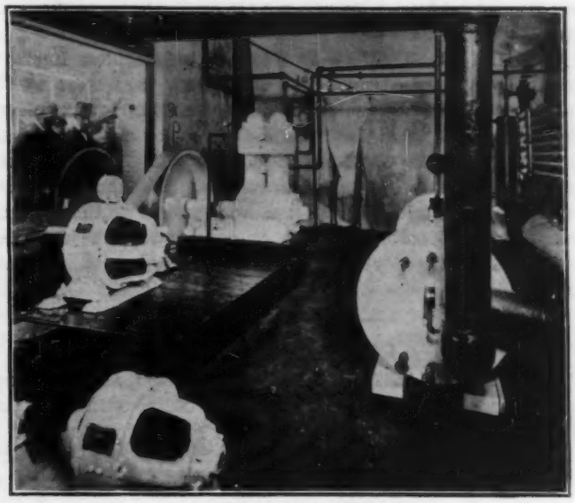
This particular solution of the problem of enforcing obedience to signals is modern and consistent with best practice in other departments of railroad operation..

With the restoring of the signal to clear the speed control device is cut out automatically, and, in fact, its presence is never apparent if the engineer does his simple duty.

A third development of the Simmen System is indicated by the third illustration, which shows the Simmen train record sheet, whereby the movement of trains is recorded automatically in the dispatcher's office. In connection with the record sheet there is provided a signal control lever for certain groups of signal ramp rails (usually all the rails located at one passing point) by means of which the dispatcher can at will deenergize the rails and give a danger indication to a train. These groups of signal rails are tied in to one wire, which extends direct to the dispatcher's office and to the lever controlling that point. This lever is connected to the positive side of a station battery when inclined to the right and to the negative side of a station battery when inclined to the left. In the vertical position there is no connection and the line is dead.

MOVABLE ICE PLANT FOR ROAD SHOW.

It is one thing to stage an ice ballet in the New York Hippodrome, where the show runs for an entire season, and quite another thing to transport a skating rink around the country with only a short run in each place. When it was decided to send the Hippodrome Company on the road, keeping intact the entire spectacles of "Around the World," including "Flirting at St. Moritz," the most brilliant ice ballet ever staged, the one serious drawback was the problem of furnishing a suitable ice pond. The adoption of the ice plant shown by the illustration proved to be the solution. The various units of this plant are transportable, each being mounted on a skid or stand, so that when the show closes it is only necessary to take down the piping, haul the different pieces of apparatus on a truck, pack them into a car and ship to the next showing place. To prevent the loss



Ice Plant in Operation.

of time required to erect the plant and freeze the water, which takes 24 hours, duplicate outfits are used. While one is working in one city the other is being set up at the next point, so that everything is in readiness when the company arrives. The first plant then goes to the succeeding point.

Each plant consists of a 10-ton York compressor, with two cylinders each 6½x6½ in., driven by a 20 h.p. direct current Westinghouse motor, and a 60 kw. Westinghouse motor generator set. Where direct current is available, the motors are operated from the power circuit, but as usually only one alternating current is to be had, the motor generator set is used to transform the alternating current into direct current for the operation of the motors.

The brine tank has a capacity of 1900 gallons. The ice pond formed on the stage is 45 ft. long, 20 ft. wide, and 4 in. deep. While being frozen, the water is held in place on the stage by a canvas tub.

These battery connections are identified with the direccurrent for the direction in which the locomotive is moving, when a signal rail is energized with the proper polarity of tional movement of trains for signal track operation, so that the engineer will get a green signal through the polarized relay on the locomotive. No current or current of the opposite polarity will cause the red light to burn. At the same time that the locomotive shoe makes the contact with the signal rail, the circuit through the dispatcher's office is completed to ground, and the record of the train at that point is punched on the dispatcher's sheet. This sheet moves at the rate of six inches an hour downwards.

The recent impetous of ice-skating on the Pacific Coast should make this new movable ice plant operation of unusual interest to electrical engineers.

NEW ELECTRICAL DEVELOPMENTS

(The constant stream of electrical development throughout the West is the very artery by means of which electrical activity is energized. Herein will be found the latest news in electrical development of this section.—The Editor.)

FINANCIAL.

LOS ANGELES, CAL.—In order that the city may be in a position to buy the distributing system of the Los Angeles Gas & Electric Corporation as well as the Southern California Edison and Pacific Light & Power Corporation systems, the People's Power bond committee of 100 have recommended to the Council that the bond issue be for $15,000,000. President Betkouski said that he would oppose a larger bond issue than the $12,000,000 proposed by the city power committee.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company has transferred its utility properties to the Washington-Idaho Water, Light & Power Company, by deeds recorded at Lewiston, Asotin and Colfax, for a consideration of $1,000,000. The Washington-Idaho Light & Power Company was recently organized by Liggett, Hychborn & Company of New York and Boston, which firm authorized an issuance of $5,000,000 in bonds to cover the sale just completed and future developments and subsequently acquired property.

INCORPORATIONS.

SEATTLE, WASH.—The Valley Gas Company has been incorporated by C. W. Clark and F. T. Ellis, with a capital stock of $25,000.

BOISE, IDAHO.—The Canyon Light & Power Company of Wallace with a capital stock of $100,000 has filed articles of incorporation.

SEATTLE, WASH.—The Mason Electric Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are S. W. Mason and R. G. Kendrick.

RIVERSIDE, CAL.—Articles of incorporation have been filed by the Rialto Light & Power Company and also certificates of proceedings for changing the principal place of business from Rialto to Riverside.

ILLUMINATION.

IMPERIAL, CAL.—A contract has been signed with the Holten Power Company for lights for the streets here.

HANFORD, CAL.—The new owner of the Lacey electric plant proposes to install a new street lighting system.

CHICO, CAL.—The residents of Chico Vecino have petitioned the supervisors to call an election for the formation of a lighting district.

SEATTLE, WASH.—The validity of $3,000,000 bond issue authorized by the council for extending the light plant will be tested in the court.

BREMERTON, WASH.—A franchise for the installation of a gas plant has been granted by the city of Bremerton to E. L. Blaine of Seattle.

VISALIA, CAL.—South Bridge street property owners are considering plans for lighting their street by means of a system similar to that on West Main street.

KLAMATH FALLS, ORE.—An up-to-date street lighting system is shortly to be installed here by the California-Oregon Power Company at a cost of over $10,000.

WHITE SULPHUR SPRINGS, MONT.—P. J. Twohy completed a deal becoming lessee of the White Sulphur Springs electric light plant. New machinery is being installed.

SALINAS, CAL.—The mayor has appointed the entire council a committee to work with the chamber of commerce on getting work started on the proposed electrolier system.

PALOUSE, WASH.—At a mass meeting the citizens favored a street lighting system, and a committee from the Chamber of Commerce will work with the council in securing the system.

BAKERSFIELD, CAL.—Signatures of property owners on the proposed electrolier system for the business district are being readily secured. The system will mean an outlay of about $30,000.

PHOENIX, ARIZ.—Residents of the Higley section have voted to establish an electrical district. Property owners of the district hope to dispose of bonds for the purpose of providing electricity for that section.

MODESTO, CAL.—An election will be held on January 6, to determine whether or not certain territory shall be organized as a public highway lighting district to be known as the Cross Landing Lighting District of Stanislaus County.

PORT ANGELES, WASH.—The city council has accepted the bid of Oscar P. Dix & Company, bond dealers of Seattle, for the purchase of $25,000 worth of electric utility bonds. The money is to be used for the extension of the light service.

WHITTIER, CAL.—The board of trustees has awarded the contract for reinforced concrete lighting posts together with wires, conduit, etc., to be installed along Philadelphia street from Painter avenue, to the westerly boundary line of the city to John L. Wilson, at $7398.

FERNDALE, CAL.—Manager Jackman of the Western States Gas & Electric Company, in reply to the town's request that the company's lines be extended, has made a proposition for the town to enter into a contract with his company for the installation of an up-to-date street lighting system in all parts of town.

MERCED, CAL.—The city trustees have taken under consideration a plan whereby the city would become local distributor of electric power furnished by the San Joaquin Light & Power Corporation. City Engineer C. D. Martin has been delegated to make an investigation. Upon his report will depend the further action to be taken by the trustees.

PORTLAND, ORE.—An investigation of the financial condition of the Portland Railway, Light & Power Company, with a view of making the results public is to be the purpose of a committee to be appointed as a result of a mass meeting held in the Central Library recently. Commissioner Daly declared that with a municipal lighting plant the cost of electric lighting could be cut materially. He explained that a bond issue would be necessary to provide for the establishment of such a plant, however.

TELEPHONE AND TELEGRAPH.

OXNARD, CAL.—A resolution approving the consolidation of the telephone systems in Oxnard has been adopted by the Board of Trade.

PENDLETON, ORE.—The Pacific Telephone & Telegraph Company plans to completely remodel the telephone system here at a cost of $15,000.

BREMERTON, WASH.—The government will lay a telegraph and telephone cable between the Navy Yard and the U. S. signal office in Seattle.

VANCOUVER, B. C.—The city has secured an option for obtaining all rights for the proposed power plant on Bridge River near Lilloet River, at a cost of $40,000.

BREMERTON, WASH.—The date of opening bids for the construction of a telephone and telegraph line between this place and Keyport has been extended from December 18th to January 10th.

BUTTE, MONT.—Western railways, including the Great Northern, Northern Pacific, Chicago, Burlington & Quincy, Milwaukee, and others, are to join in the construction of 48,000 miles of telegraph lines in the Northwest.

POMONA, CAL.—It is announced that a new building to cost about $50,000, is to be erected here for the Home Telephone Company. Plans are now being prepared. J. F. Blee is engineer.

SAN FRANCISCO, CAL.—An additional floor is to be added to the Bankers' Investment Building at Market and Geary streets. It is understood that the Western Union Telegraph Company is to occupy the entire new floor.

BREMERTON, WASH.—A telegraph and telephone cable will be laid between the navy yard and the U. S. Signal office in Seattle, according to the authorization just received from the navy department. The cable will be run under water.

PHOENIX, ARIZ.—The Western Union Telegraph Company has been given permission by the city commission to construct a conduit from the Arizona-Eastern to the city telegraph office on Central avenue. At present the wires of the Western Union pass through the telephone company's conduit from Jackson street.

TRANSMISSION.

ARBUCKLE, CAL.—The Northern California Power Company is preparing to install a substation here.

LOS ANGELES, CAL.—The city's power bureau has commenced installing poles for the main transmission line from the southern part of the city to the harbor district.

SEATTLE, WASH.—The Electric Heating & Manufacturing Company, 1812 Ninth avenue S., has a permit to repair the manufacturing plant at the same, the additional cost to be $2200. E. J. Rounds Construction Company, Walker Building, are the contractors.

SOUTH PASADENA, CAL.—The Pacific Light & Power Corporation has decided to remove its substation from South Pasadena to another location outside of the city limits. The company asks for a reasonable length of time in which to get established in the new location.

NEWPORT, WASH.—The Northern Idaho & Montana Power Company, represented by Attorney Whelan of Sandpoint has made application for a franchise to build a high-power transmission line along the highway from Newport to and through the town of Dalkena.

ABERDEEN, WASH.—An ordinance introduced provides for granting a franchise for a heating plant for the Finch building, old Livingston building, S. J. Johnston Transfer Company building, post office and others, owned by W. J. Patterson, C. M. Weatherwax and others.

OLYMPIA, WASH.—With 40 representatives of electric light and power companies and 12 representatives of electrical workers unions attending, the public service commission recently began final hearing on the proposed changes to the overhead construction rules affecting these companies.

SEATTLE, WASH.—Plans are to be started shortly by City Architect Daniel Huntington for a building to house an addition to the steam plant on Lake Union, same to be of reinforced concrete and cost $50,000 to $60,000. There is to be a concrete bulkhead and the use of 500 piles.

SEATTLE, WASH.—An ordinance has been passed by the council authorizing issuance of $3,000,000 in utility bonds for purchasing a completed hydroelectric power plant. The board is authorized to advertise for bids for generation of 13,000 kw. of continuous energy capable of generating 25,000 kw. for a period of 5 hours each day.

LEWISTON, IDAHO.—The Washington-Idaho Water, Light & Power Company, recently organized by Liggett, Hichborn & Company, New York and Boston, has purchased the power and irrigation interests of the Lewiston-Clarkston Improvement Company. The plans of the purchasers include the construction of a dam on Snake River that will develop 50,000 h.p. and raise the harbor depth at Lewiston 8 ft.

BANNING, CAL.—The Southern Sierras power line will be extended from Imperial Valley centers to the Colorado River. A contract has been made between the Southern Sierras Company and the Imperial Irrigation District, whereby the Coachella Ice & Electric Company, subsidiary of the Southern Sierras Company, constructs a high tension transmission line from either Niland or El Centro to Hanlon Heading. The cost of the line will be about $200,000.

KLAMATH FALLS, ORE.—Indignant at the action of the city council Monday in voting down the franchise of the Keno Power Company to sell electricity in Klamath Falls, after the question had been submitted to a straw vote of the people and passed by a vote of more than four to one, citizens recently packed the city hall and voiced their feeling in speeches of denunciation. The council had held that after going over the franchise it was found to lack protection of the city's interests and that a new ordinance should be drawn up embodying amendments to this effect.

TRANSPORTATION.

LOS ANGELES, CAL.—Henry M. Densino has applied for a franchise for the construction of a double-track electric railway on Main street from Slauson avenue to Manchester avenue.

SAN FRANCISCO, CAL.—President Jesse Lilienthal of the United Railroads has announced an advance in pay to all its street car platform employes, to become effective on January 1st. The new schedule will mean an advance of more than $100,000 yearly to the pay roll of the corporation.

IRRIGATION.

SUSANVILLE, CAL.—Colonel Carl J. Younger is making preliminary arrangements for starting work in the spring on the construction of the Petes Valley irrigation project. He guarantees to have water ready for distribution in the spring of 1918. The federal authorities have given a right of way over the government land which it is necessary for the ditches to cross.

WASHINGTON, D. C.—The reclamation commission unanimously recommended to Secretary Lane that he urge on Congress the appropriation at this session of $400,000 for the construction of the Warm Springs dam on the Malheur irrigation project and that he further urge the appropriation of another $400,000 to build the storage dam of the Owyhee project in Oregon. Coupled with these recommendations was one favoring an appropriation of $200,000 for the King Hill project in Idaho.

FRESNO, CAL.—For the purpose of receiving the report of Lewis C. Hill, consulting engineer for the government, on the proposed plan to construct a reservoir at Pine Flat on Kings River, a meeting of the committee of thirty of the Kings River Control and Conservation District will be held. If 1,000,000 acres are included in the system the reservoir will cost $8.75 per acre with sand-cement construction and $9.53 per acre with the use of the stone. The irrigation system will take in the present 600,000 acres now under irrigation and 400,000 that will be placed under cultivation.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co
Los Angeles; 755 Folsom St., San Francisco; Seattle.

B-1 Baker-Joslyn Company 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

I-1 Benjamin Electric Manufacturing Co .....
590 Howard St., San Francisco.

C-1 Century Electric Co 14
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co 16
87 New Montgomery St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co .....
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co .....
Chicago, Ill.

D-2 Dearborn Chemical Company 13
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co .....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Co 14
206-8-10 First St., (near Howard), San Francisco.

E-3 Electric Agencies Co .....
279-283 Minna St., San Francisco; 419-421 E. Third St., Los Angeles.

E-4 Electric Storage Battery Co 11
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co 12
34 Second St., San Francisco.

E-6 Electric Novelty Works .....
533 Mission St., San Francisco.

E-7 Economy Fuse & Mfg. Co .....
Kinzie and Orleans Sts., Chicago.

F-3 Federal Sign System (Electric) 13
618 Mission St., San Francisco.

G-1 General Electric Co 20-21
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

H-1 Habirshaw Electric Cable Co., Inc 17
(See Western Electric Company.)

H-2 Hemingray Glass Co 13
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 Haller-Cunningham Electric Co 12
428 Market St., San Francisco.

H-4 Hubbard & Co 19
(See Pacific States Elec. Co.)

H-7 Hurley Machine Co 17
New York and Chicago. (See Pacific States Electric Co.)

I-2 Illinois Electric Co .....
261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co 14
111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co 12
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co 4
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co 12
San Rafael, Cal.

M-3 Moore & Co., Charles C 13
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

M-4 Morse Chain Company 5
Monadnock Bldg., San Francisco.

N-1 Nason & Co., R. N .....
151 Potrero Ave., San Francisco.

N-2 National Conduit & Cable Co., The .....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co 15
(All Jobbers.)

N-4 New York Insulated Wire Co 11
629 Howard St., San Francisco.

N-6 National Carbon Co 22
Cleveland, Ohio.

O-1 Okonite Co. (The) 22
(All Jobbers.)

P-2 Pacific States Electric Co 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co 12
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co 16
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 Pittsburgh Piping & Equipment Co 22
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The 16
211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co 18
Flood Bldg., San Francisco.

S-5 Sprague Electric Works 11
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co .....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Central Bldg., Seattle, Wash.; 815 Newhouse Bldg., Salt Lake City, Utah.

T-1 Thomas & Co., R 15
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company .....
Pawtucket, R. I.

U-1 United Sheet Metal Works .....
575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company 1
St. Louis, Mo.

W-2 Western Electric Co .....
Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 Ward-Leonard Electric Co 16
Mt. Vernon, New York.

W-4 Westinghouse Electric & Manufacturing Co 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; First National Bank Bldg., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-6 Westinghouse Lamp Co .....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co .....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.

W-9 Weston Electrical Instrument Co 22
109 Weston Ave., Newark, N. J.; Frank E. Smith, 682 Mission St., San Francisco.

Devoted to the Conversion, Transmission and Distribution of Energy

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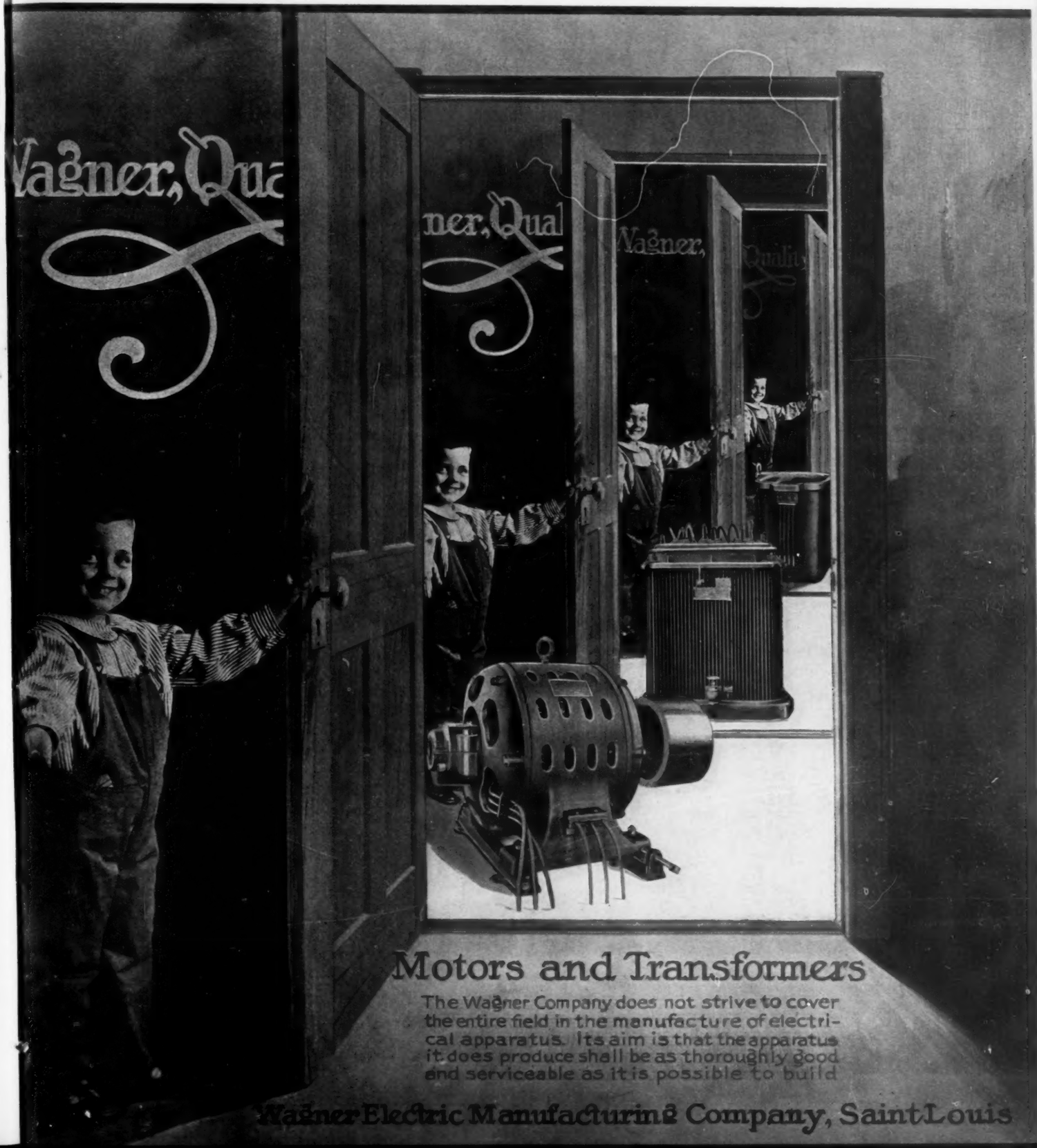


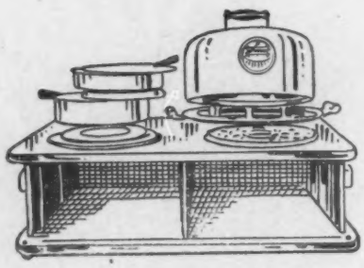
Motors and Transformers

The Wagner Company does not strive to cover the entire field in the manufacture of electrical apparatus. Its aim is that the apparatus it does produce shall be as thoroughly good and serviceable as it is possible to build

Wagner Electric Manufacturing Company, Saint Louis

UNIVERSAL

Electric Home Needs



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FIRST in Safety, Efficiency, Convenience, Durability and satisfaction.

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